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STUDENT WORKBOOK

MILITARY PLUMBING SYSTEMS

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This supercedes publications dated prior to January 1986.

INTRODUCTION

This block of instruction covers military plumbing systems and is designed to enhance your abilities as an Engineer Non-Commissioned Officer. It will provide you with the necessary information to enable you to supervise, control, and inspect a plumbing system in the Theater of Operations.

T/O PLUMBING BLOCK OUTLINE

TITLE
PLUMBING SYSTEMS

BLOCK		HOURS
5140-C7	Plumbing Theory	3
5140-C8	Plumbing Calculations	3
5140-C9	Plumbing Blueprints & BOM Adjustments	4
5140-C10	Plumbing Construction Inspection PE	6
5140-C11	Plumbing Exam	2

REFERENCES:

1. Student Workbook
2. National Plumbing Code
3. TM 5-302 Extract
4. TM 5-551K Plumbing and Pipefitting
5. TM 5-163 Sewerage

READEX FICHE best copy available

MILITARY PLUMBING SYSTEMS

WATER SYSTEMS

There are five types of pipe generally used in the water supply system. They are:

a. Service Main

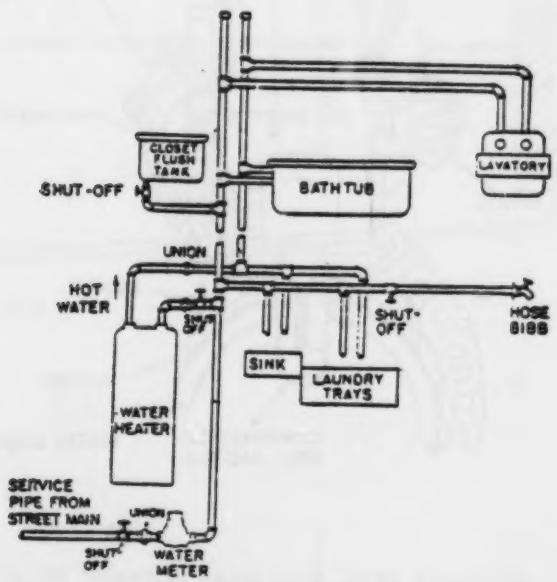
b. Main Supply

c. Supply Branch

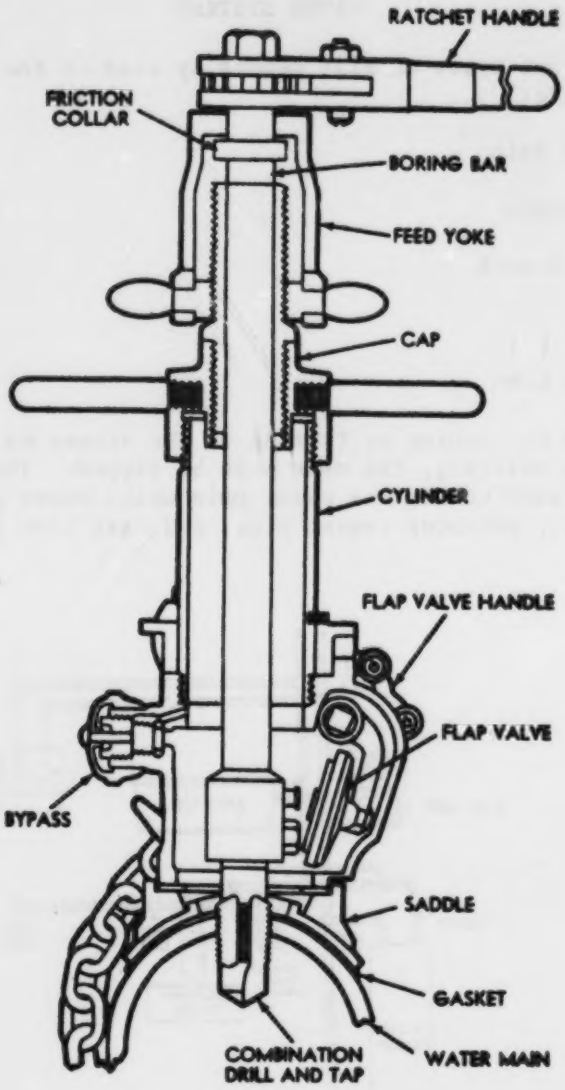
d. Riser

e. Fixture Line

If there is no opening or fitting in the street main for water from the main to the building, the main must be tapped. The tapping machine (next page) is used to tap the water main while under pressure. It can be used on steel, asbestos cement pipe, and cast iron pipe.



TAPPING MACHINE



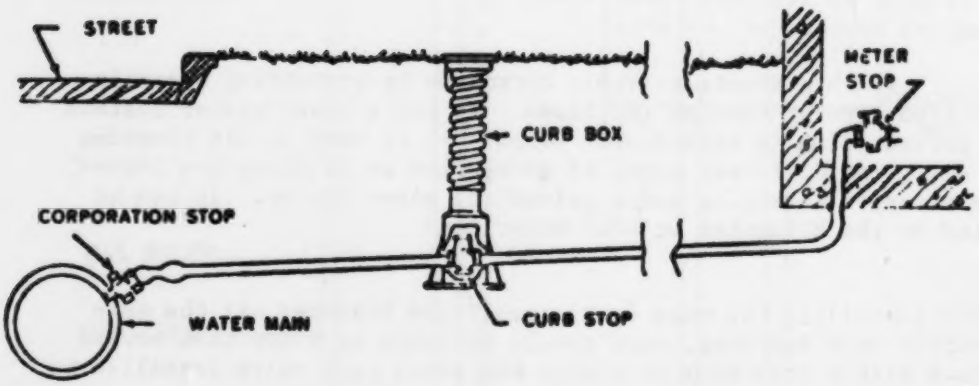
The water supply line coming from the water main to the building should be a minimum of 3/4 inch inside diameter.

There are normally 3 valves on this line, however, in the theater of operations there may be only 2. They are shown in the drawing below:

The valve that is installed when the water main is tapped is called a Corporation Stop.

The valve normally installed inside a protective box between the street and house is called a Curb Stop. It is used to turn off the water for repairs.

The valve installed normally inside the foundation wall is called a Meter Stop.



WATER SERVICE FROM MAIN INTO BUILDING

The water lines must extend to the various parts of the building and to the water heater. The basic connections to the lines are as follows:

1. Valves and unions on the hot and cold waterlines.

The heater contains the following control devices:

1. Temperature and Pressure relief valves.

2. Dip tube and siphon hole.

3. which protects against corrosion and rust. It dissolves in the water and coats the inside surface of the water heater and storage tank. It must be replaced about every depending on the chemical content of the water.

4. which prevents galvanic corrosion by preventing electric current from flowing through the lines. It has a fiber washer instead of the ground joint in an ordinary union. It is used in the plumbing system where two different types of metal pipe or fittings are joined, such as a copper waterline and a galvanized water heater. It can be installed on the HOT water or COLD waterlines.

When installing the main water supply and branches off the main water supply in a building, care should be taken to slope them toward the source with a drip cock or a stop and waste cock valve installed to allow for draining them.

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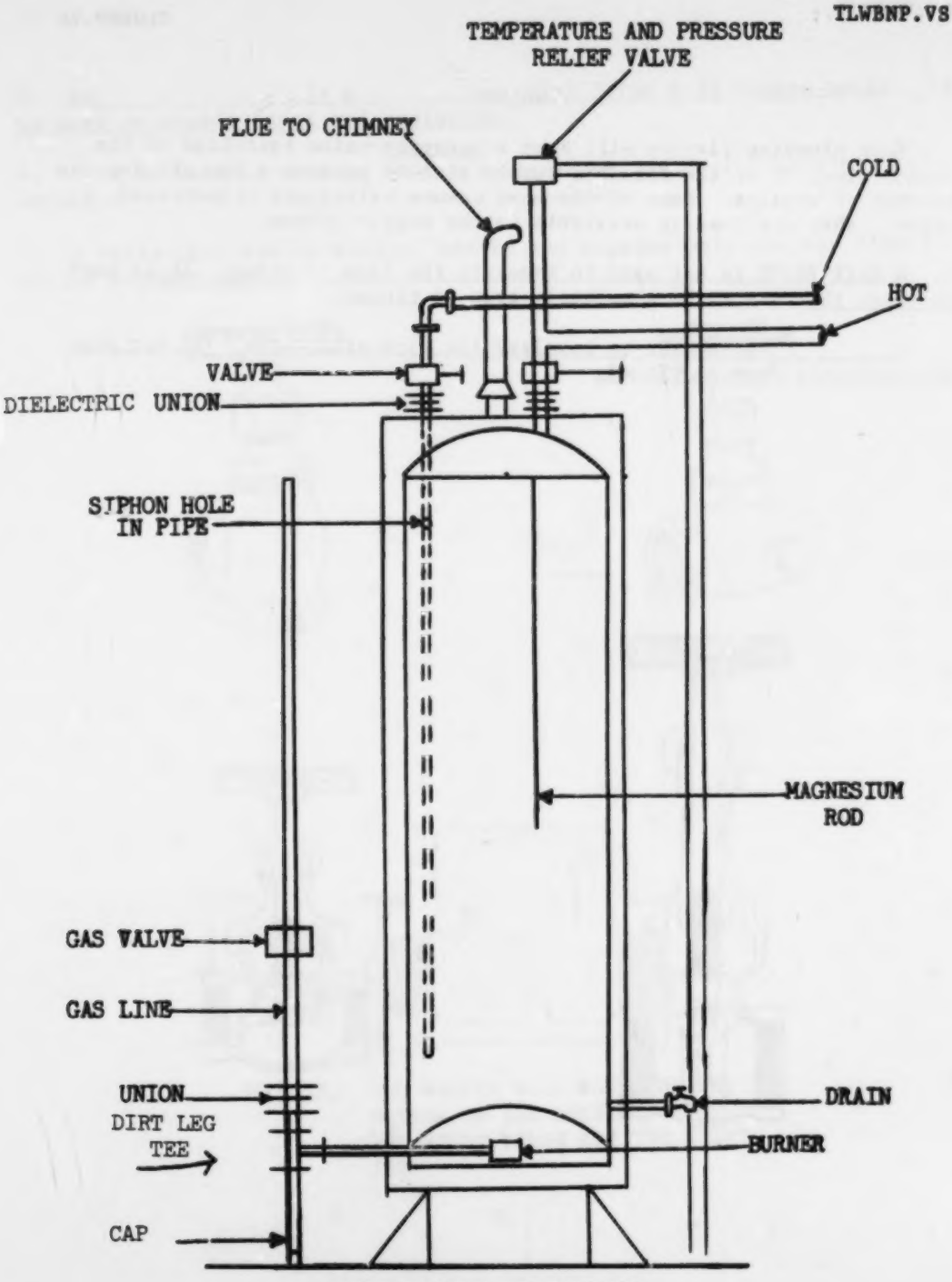


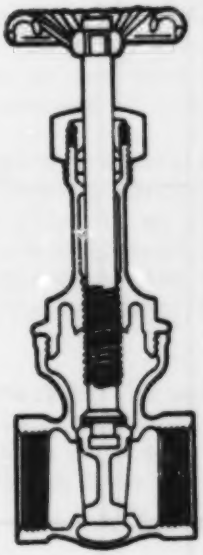
WATER HEATER CONNECTIONS

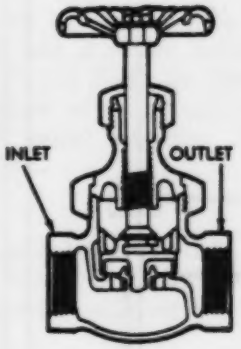
VALVES

Each plumbing fixture will have a separate valve installed on the branch line, or on the flexible supply line to provide a shutoff for the purpose of repairs. Some of the most common valves are illustrated below. They are readily available in the supply system.

1. A GATE VALVE is not used to regulate the flow of water. It is used on lines that are to be completely open or closed.

2. A _____ _____ is used to regulate the flow of liquids. It may also be completely open or closed.

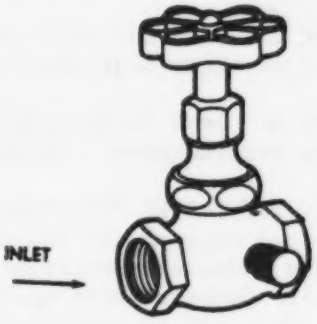


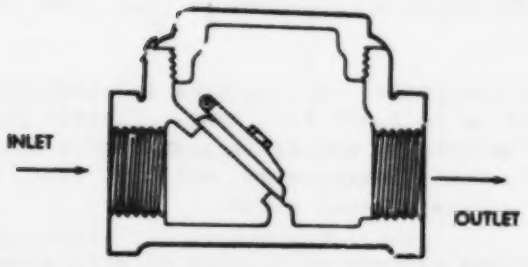


3. An _____ is a _____ that forms a 90 degree angle. It is used on supply lines and radiators.

4. A valve that is used to shut off the water and drain the pipes is called a _____ and _____ valve.

5. A valve that has no stem or handle and permits only one way flow is called a CHECK VALVE.





NOTE: ALL VALVES WILL HAVE THE PSI RATING ON THE HOUSING. USE THE RIGHT VALVE FOR THE RIGHT JOB.

PIPE

There are many types of pipe which can be used in the plumbing system. A few have been listed below:

1. Copper Tubing

a. Type K - used for underground water supply (hard and soft temper).

b. Type L - used for water supply above ground. Used for most military and civilian construction. (hard and soft temper)

c. Type M - used in heating systems, interior water distribution, and exterior service pipe. (hard and soft temper)

d. Type DWV - used for drain waste and vents (hard temper only).

Copper tubing (rigid) comes in sizes from 1/8 inch to 4 inches in 20 foot lengths. Copper tubing soft temper (flexible) comes in coils of 40 and 100 feet, and in sizes from 1/8 inch to 3/4 inch. Copper tubing is joined together by soldering, flaring or compression rings.

2. Plastic Pipe

The most common plastic pipes are PVC (polyvinyl chloride) and ABS (acrylonitrile butadiene stryrene). ABS is usually black in color and PVC is usually gray and white. Both types are manufactured in rigid or flexible form. The rigid pipe ranges in size from 1/2 inch to 20 inches in 20 foot lengths.

The flexible pipe ranges in size from 1/2 inch to 4 inches in both hot and cold coils up to 3,500 feet long. Plastic pipe is used on water supply, water distribution, and drain waste and vent. It is light weight, easy to install, inexpensive, will not rust, rot or corrode and under normal use outlasts metal pipes.

There are various methods of joining plastic pipe and fittings. One of the most common methods is to apply solvent cement to the pipe and fitting and insert the pipe into the fitting. The solvent cement fuses them in seconds forming a leak proof joint.

Another method uses a bell, or hub and rubber gasket similar to the ones used on asbestos-cement pipe, while still another uses a cold flare similar to flaring copper tubing. Finally, another uses heat to fuze the pipe and fitting together.

3. Cast Iron Soil Pipe

Cast iron comes in two weights:

Service Weight is used for most military and civilian construction.

Extra heavy is used for tall stacks, under roadways, for corrosive liquids and where extra strength is required. Cast iron is used for:

a. Sewers
b. Drains
c. Stacks
d. Vents

It is manufactured in 5 and 10 foot lengths and sizes from 4 to 48 inches (both single and double hub).

Joints are made by placing the spigot end of one pipe into the fitting, or the hub of another pipe; the packing with oakum, pouring melted lead into the hub and caulking with a caulking iron.

Cast iron soil pipe is expensive, and can be very heavy and difficult to install. Much time and skill are required to install cast iron properly.

4. Steel Pipe

Steel pipe is manufactured in plain (black) or galvanized (coated with zinc) in lengths of 21 feet. Inside diameter sizes from 1/8 inch and larger.

In most sizes steel pipe is available in 3 weights, or 3 lengths.

a. Standard: Used in most installations for hot and cold water supply.

b. Extra Strong: Used for gas and air lines.

c. Double Extra Strong: Used in drain, waste and vents.

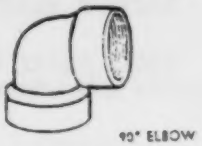
Galvanized and black iron pipe come threaded on both ends with a coupling. This allows assembly of one joint with the next.

FITTINGS

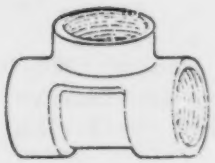
Fittings are used to join two sections of pipe, make a change in direction, reduce the size of the line, cap the end of the line or plug another fitting.

Some of the common fittings are:

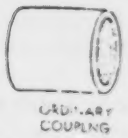
1. Elbows, (Ells or L's)



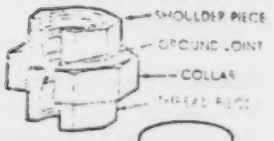
2. Tees or (T's)



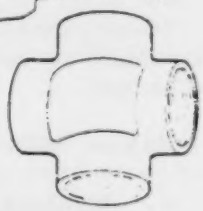
3. Couplings



4. Unions
   * very important fitting



5. Crosses

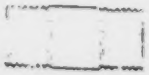


6. Bushings

7. Caps

8. Plugs

9. Nipples



The water system like the waste system must be sized. There are six factors in sizing the interior waterline, they are:

1. NUMBER AND TYPE OF FIXTURES
2. TOTAL FIXTURE UNITS (1 FU = 7.5 GPM)
3. DESIGN LOAD GALLONS PER MINUTE (GPM)
4. TYPE OF PIPE
5. LENGTH OF RUN
6. PRESSURE AT SOURCE POUNDS PER SQUARE INCH (PSI)

Table 10-2. Design Load Versus Fixture Units Mixed System, Middle Part of Range.

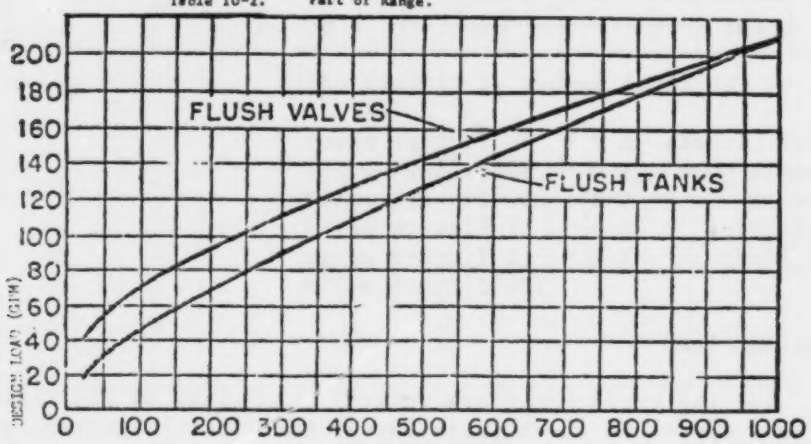
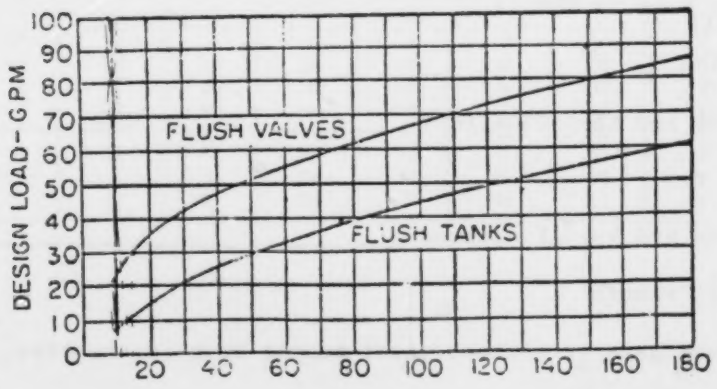


Table 10-2. Design Load Versus Fixture Units Mixed System, Lowest Part of Range.



Using these steps size a system that has the follwing fixtures. 10 water closets, 10 urinals, 20 showers, 15 lavatories, and 2 slop sinks.

FIXTURE UNIT TABLE

1.

FIXTURES	UNIT VALUE
Drinking Fountain	1/2
Lavatory or wash basin	1
Floor drain	1
Kitchen sink	2
Bathtub	2
Laundry tray	2
Shower	2
Slop sink	3
Urinal	5
Water closet	6

TM 5-551K
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2. Calculate the total number of fixture units

10 water closets	X 6 =	60 fixture units
10 urinals	X 5 =	50 fixture units
20 showers	X 2 =	40 fixture units
15 lavatories	X 1 =	15 fixture units
2 slop sinks	X 3 =	6 fixture units
		171 fixture units

3. Find design load

Page use the curve for flush valves, read right to 171 fixture units then up to the flush valve curve, then left to gallons per minute.

The design load in GPM is _____

4. Type of Pipe

Check plans and specifications _____

5. Length of run

Check plans and specifications _____

6. Pressure at source

Use pressure gage or contact water supply unit in the area.

Pressure PSI is _____

Now that the six factors have been determined size the main line using the following charts.

The size of the main line is _____

CAPACITIES OF PIPE IN GALLONS PER MINUTE (GALVANIZED IRON)

a.3/8 inch

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	5	3	3	2	2	2	....	....	....	....
20	9	5	4	3	3	3	2	2	2	2
30	10	6	5	4	4	3	3	3	3	2
40	....	8	6	5	4	4	4	3	3	3
50	....	9	7	6	5	4	4	3	3	3
60	....	9	7	6	6	5	5	4	4	4
70	....	10	8	7	6	6	5	5	4	4
80	....	....	8	7	7	6	5	5	5	4

b.1/2 inch

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	10	8	5	5	4	3	3	3	3	3
20	14	10	8	6	6	5	5	4	4	4
30	18	12	10	8	8	7	6	6	5	5
40	20	14	11	10	10	8	7	7	6	6
50	....	16	13	11	11	9	8	7	7	7
60	....	18	14	12	12	10	9	9	8	7
70	....	....	15	13	12	11	10	9	8	8
80	....	....	....	....	....	....	....	....	....	....

c.3/4 inch

Galvanized Iron

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	22	14	12	10	8	8	7	6	6	6
20	30	22	18	14	12	12	11	10	10	8
30	38	26	22	18	16	14	13	12	12	10
40	....	30	24	21	19	17	16	16	15	13
50	....	34	28	24	21	19	18	17	16	15
60	....	38	31	26	23	21	20	19	18	17
70	....	....	34	29	25	23	22	21	19	18
80	....	....	36	30	27	24	23	22	21	20

CAPACITIES OF PIPE IN GALLONS PER MINUTE (GALVANIZED IRON)

d. 1 inch

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	40	28	22	18	16	15	14	13	12	11
20	55	40	32	27	24	22	20	19	18	16
30	70	50	40	34	30	27	25	23	22	20
40	80	58	45	40	35	32	29	27	25	24
50		65	57	45	40	36	33	31	29	27
60		70	58	50	44	40	36	34	32	30
70		76	63	54	45	42	40	37	34	32
80			65	57	47	43	39	37	35	33

e. 1 1/4 inch

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	80	55	45	37	35	30	27	25	26	24
20	110	80	65	55	50	45	41	38	36	34
30		100	80	70	60	56	51	47	45	42
40			95	80	72	65	60	56	52	50
50			107	92	82	74	68	63	60	55
60				102	90	81	75	70	65	62
70					97	88	82	74	69	67
80					105	95	87	79	74	72

f. 1 1/2 inch

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	120	90	70	60	55	50	45	40	40	35
20	170	130	100	90	75	70	65	60	55	55
30		160	130	110	100	90	80	75	70	65
40		170	150	130	110	100	90	90	80	80
50			170	140	130	120	110	100	90	90
60				160	140	130	120	110	100	100
70				170	150	140	130	120	110	100
80					160	150	140	130	120	110

g. 2 inch

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	240	160	130	110	100	90	90	80	80	70
20	300	240	200	160	150	140	130	120	110	100
30		300	240	200	180	160	150	140	140	130
40			280	240	220	200	180	160	160	150
50				280	240	220	200	200	180	160
60					280	240	220	200	200	180
70					300	260	240	220	220	200
80						280	260	240	220	220

CAPACITIES OF PIPE IN GALLONS PER MINUTE (COPPER AND PLASTIC)

a.1/2 inch

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	8	5	4	3	3	2	2	2	2	2
20	12	8	6	5	5	4	4	3	3	3
30	15	10	8	7	6	5	5	4	4	4
40	17	12	9	8	7	6	6	5	5	4
50	....	14	10	9	8	7	6	6	5	5
60	..	15	12	10	9	8	7	7	6	6
70	..		13	11	10	9	8	7	7	6
80	..	....	14	12	10	10	8	8	7	7

b. 5/8 inch

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	12	8	7	6	5	5	4	4	3	3
20	18	12	10	9	7	6	6	5	5	5
30	22	16	12	10	9	9	8	7	6	6
40	26	18	14	12	10	10	9	8	8	7
50	....	22	16	14	12	11	10	9	9	8
60	....	24	18	16	14	13	12	11	10	9
70	..	..	20	18	15	14	13	12	11	10
80	..	..	22	19	16	15	14	13	12	11

c. 3/4 inch

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	20	14	10	10	8	8	6	6	6	5
20	30	20	16	14	12	10	10	10	8	8
30	36	26	20	17	15	14	13	11	10	8
40	..	30	24	20	18	16	15	14	13	12
50	....	34	28	24	20	18	16	16	14	14
60	....	36	30	26	22	20	18	18	16	16
70	..	..	32	28	24	22	20	18	18	16
80	..		36	30	26	24	22	20	18	18

d. 1 inch

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	50	30	24	20	18	16	14	14	12	12
20	70	45	36	30	26	24	22	20	18	18
30	80	55	45	38	34	30	28	26	24	22
40	....	65	55	45	40	36	32	30	28	26
50	.	75	60	50	45	40	36	34	32	30
60		80	65	55	50	45	40	38	36	34
70			70	60	55	50	45	40	38	36
80	....	..	80	65	60	50	50	45	40	40

CAPACITIES OF PIPE IN GALLONS PER MINUTE (COPPER AND PLASTIC)

e. 1 1/4 inch

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	80	55	42	37	32	30	27	25	22	22
20	110	80	65	55	47	42	40	35	35	32
30	....	105	80	70	60	55	50	45	42	40
40	....	110	95	80	70	65	60	55	50	47
50	....	....	110	90	80	70	65	60	57	55
60	....	....	....	105	90	80	75	70	65	60
70	....	....	....	110	100	90	80	75	70	65
80	....	....	....	....	105	95	85	80	75	70

f. 1 1/2 inch

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	130	90	70	60	50	45	40	40	35	35
20	170	130	100	90	75	70	65	60	55	50
30		170	130	110	100	90	80	75	70	65
40			155	130	115	105	95	88	80	77
50			170	150	130	120	108	100	90	88
60				165	145	130	120	110	105	98
70				170	160	142	130	122	113	106
80					170	155	140	130	122	115

g. 2 inch

Pressure at source in pounds per square inch	Length of pipe in feet									
	20	40	60	80	100	120	140	160	180	200
10	280	180	150	145	110	100	90	85	80	70
20	320	280	220	190	165	160	140	125	120	110
30	....	320	280	240	210	180	170	160	150	140
40	....	....	320	280	240	220	200	190	175	160
50	....	....	....	320	280	250	230	210	200	190
60	....	....	....	....	300	280	260	240	220	200
70	....	....	....	....	320	300	280	260	240	230
80	....	....	....	....	....	320	300	280	260	240

Once the main has been sized, you must size the branch lines. There are four branch lines that contain the following fixtures. Each branch is 100 feet long, has galvanized pipe and the pressure is 30 psi.

Branch A - 3 water closets, 2 urinals, 4 lavatories, and 5 showers.

Branch A size _____

Branch B - 2 water closets, 3 urinals, 4 lavatories, and 5 showers.

Branch B size _____

Branch C - 2 water closets, 3 urinals, 3 lavatories, and 5 showers.

Branch C size _____

Branch D - 3 water closets, 2 urinals, 4 lavatories, and 5 showers.

Branch D size _____

The last part of the system to be sized is each supply line from the branch line to the fixture. They may be sized using the table below.

(Chart for Fixture Rough-In Only)

PLUMBING	PIPE DIAMETER (inches)
Dishwasher	1/2 or 3/4
Water closet tank	1/2
Water closet diagram (flushometer) valve	1/2
Urinal with diagram (flushometer) valve	3/4
Lavatory	1/2
Shower bath	1/2
Kitchen sink	1/2
Slop sink	1/2
Scullery sink	3/4
Laundry tray	1/2
Drinking fountain	1/2
Hot water heater (domestic)	3/4
Bathtub	1/2

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Page 6-1

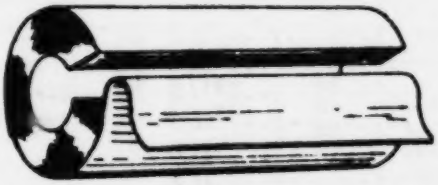
INSULATION

Insulation prevents loss of heat from hot water pipes, keeps heat out of cold water pipes, prevents freezing of hot water and cold water pipes, and prevents condensation on the outside of cold pipes. There are many different types, sizes and shapes of insulation, listed below are some of them.

is a tough, flexible rubber material. It has good insulating qualities, good cementing qualities, excellent weather-aging qualities and prevents sweating of cold water lines, it is fire and water resistant.

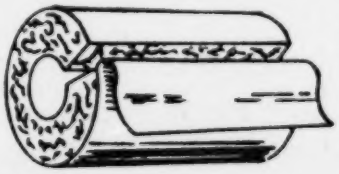
FLEX RUBBER INSULATION

is made of fine glass fibers bound together by a resin type mixture. It comes as a flexible hollow-tube slit along its length to be applied to pipes and tubing. It is also shaped to fit small boilers and hot water heaters. It is made in 3 foot lengths and from 1/2 to 2 inches thick. It has long life, will not shrink, swell, rot or burn, is lightweight and easily applied.



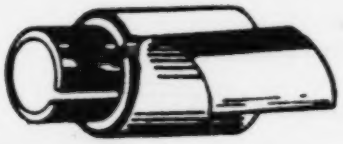
FIBERGLASS INSULATION

is made of magnesium and asbestos fibers, with a canvas cover. It is used on hot water and steam lines up to 600° F. It is made in 3 foot sections, 7/8 inch and 1 7/8 inch thick, also in powder form to make cement for fitting and valves.



MAGNESIA INSULATION

is designed for use on cold water lines, it keeps water in the pipes colder and prevents sweating of the pipes. It is made of asphalt soaked asbestos paper, as the inner layer, a 1/2 inch layer of wool felt, two layers of asphalt soaked asbestos felt, a 1/2 inch layer of pure wool felt, and an outer layer of asphalt soaked felts.



ANTISWEAT INSULATION

is used to wrap around objects that are irregular in shape, and for large flat areas. It insulates against heat loss and protects against fire. It is used on boilers, furnaces, tanks, drums, driers, ovens and valves.
It is made of asbestos cardboard, asbestos paper, wool felt and hairfelt asbestos cement blocks, air cell blocks and aluminum foil, in rolls, sheets, blocks, and strips.
It resists rats, mice and insects, and is acid and fire proof.

BLANKET TYPE

Pipe laid under ground should have a protective coating of asphalt, tar or waterproof coating to protect from rust, corrosion and electrolysis.

DANGEROUS CONNECTIONS

A cross connection is a direct or indirect connection which allows or may allow waste, sewerage or undrinkable water to flow into a potable water supply.

Some of the most common types of cross connections are illustrated below.

a. Vacuum breaker missing from flushometer valve.

b. Water inlet below overflow of fixture.

c. Waterline extended into a receptacle. All weather line must have a minimum air gap (distance between bottom of the faucet to the top of the receptacle) of 1/2 inch.

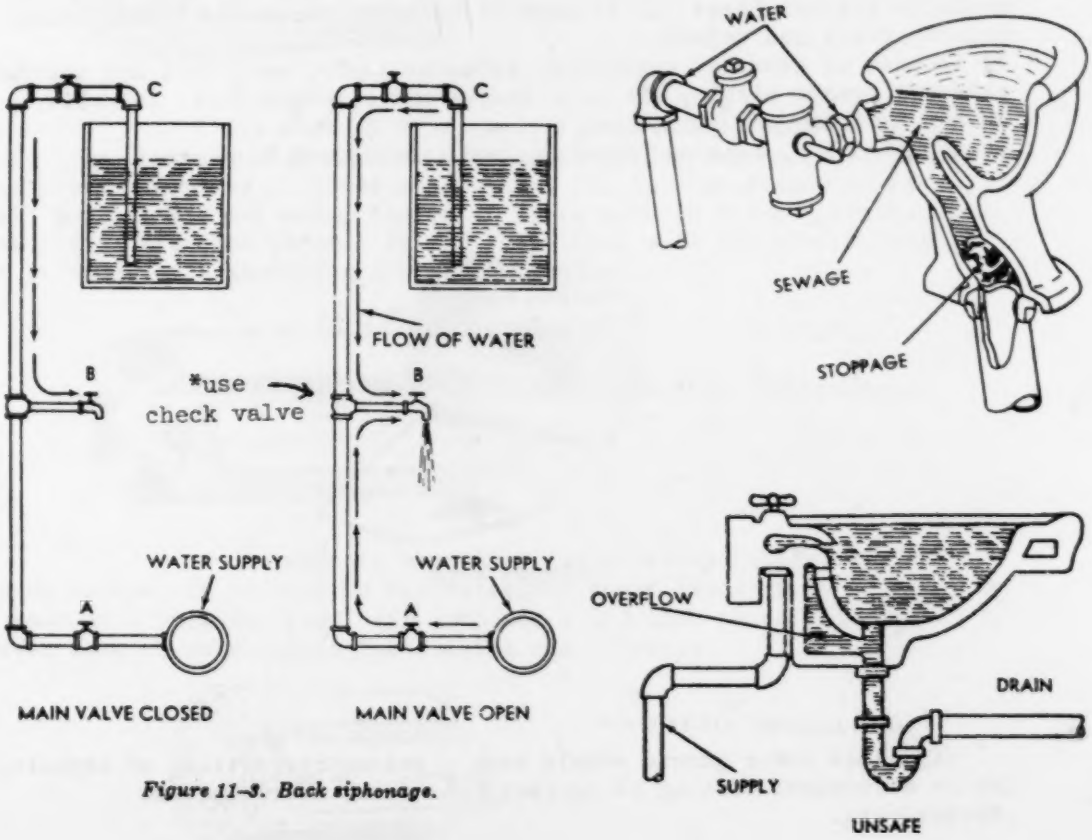
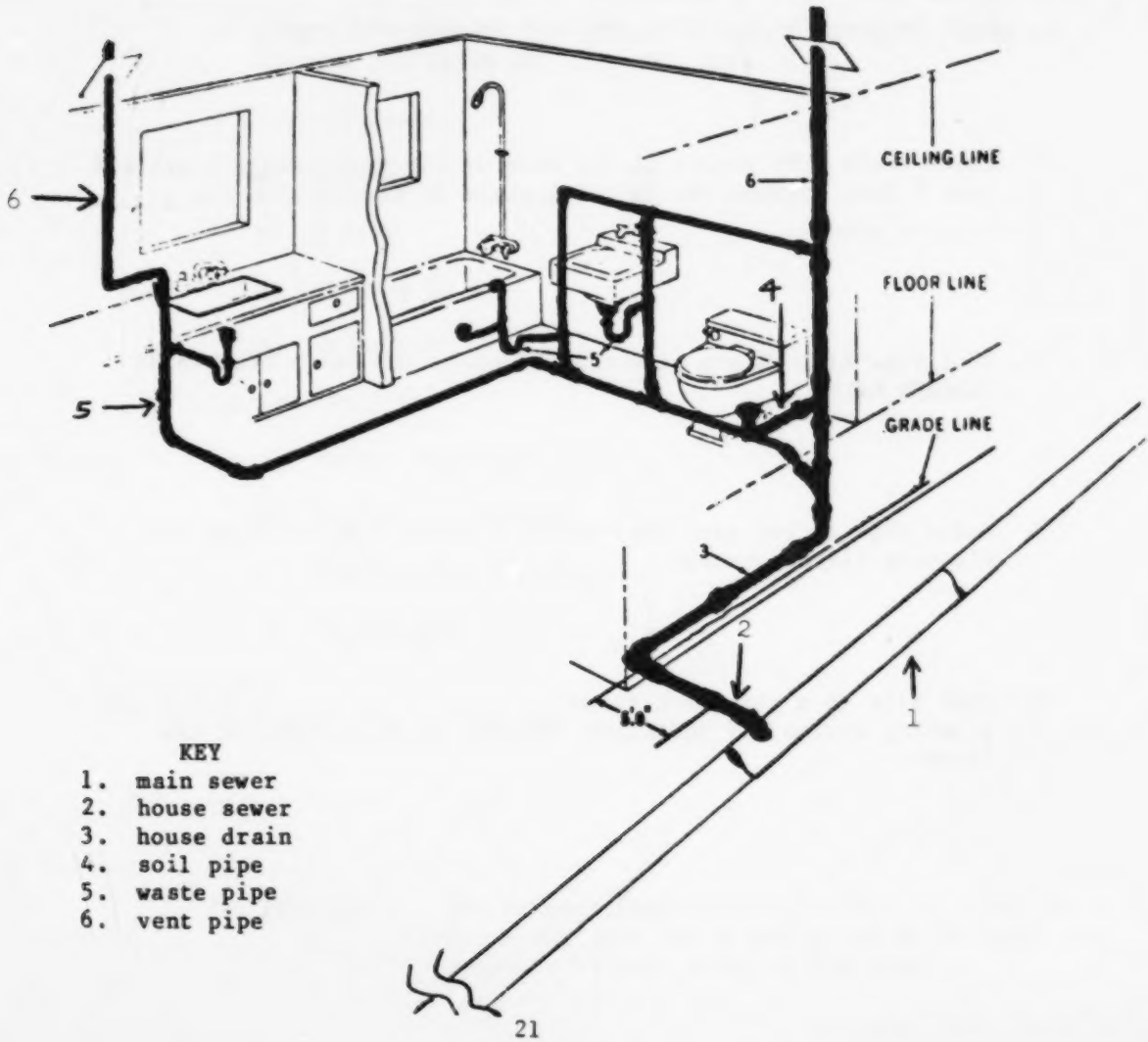


Figure 11-3. Back siphonage.

MILITARY PLUMBING SYSTEMS
WASTE SYSTEM

In the plumbing system each line has a separate function. During this part of the lesson we will describe these functions, and list the types of pipe used in the plumbing system.



KEY

1. main sewer
2. house sewer
3. house drain
4. soil pipe
5. waste pipe
6. vent pipe

2) Waste system

1) Main Sewer PIPE receives the waste from several house sewers and carries it to a TREATMENT FACILITY.

2) House Sewer PIPE IS Connected to the _____ _____ _____ feet outside the building and runs to the main sewer.

3) House Drain PIPE starts at the base of the soil, waste stack and runs 5 feet outside the building where it connects to the _____ _____ _____

4) Soil Pipe LINE IS any pipe that receives the waste from WATER CLOSETS ONLY.

5) Waste Pipe IS any pipe that receives waste from any type of plumbing fixture except _____ _____

6) Vent Pipe IS a pipe that allows _____ _____ to enter the plumbing system and EQUALIZES PRESSURE on both sides of the traps

3) Ventilation System

a) Traps

1) Function (PREVENTS THE ESCAPE OF SEWER (METHANE) GASES UP THROUGH THE DRAIN AND INTO THE BLDG.

2) Type of Traps

a) P Trap

b) S Trap

c) Running Trap

d) Drum Trap

3) Trap Seal Loss

a) Direct siphonage

b) Indirect siphonage

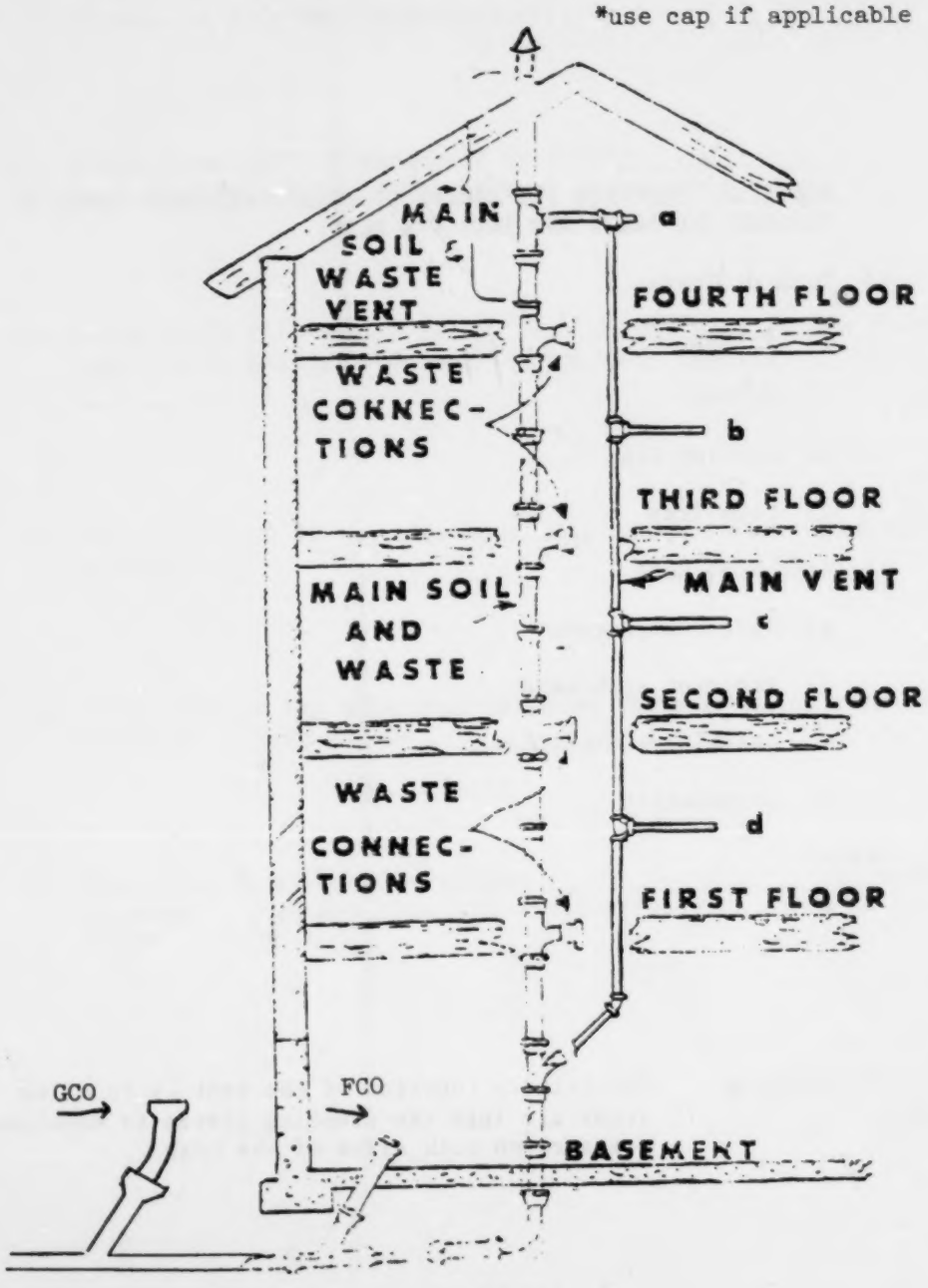
c) Capillary attraction

d) Evaporation

b) Vents

1) Function The primary function of the vent is to allow fresh air into the plumbing system to equalize pressure on both sides of the trap.

The drawing below shows the main soil and waste vent, the main soil and waste stack with soil and waste branch connections, and the main vent stack with branch vent connections.



MILITARY PLUMBING SYSTEMS

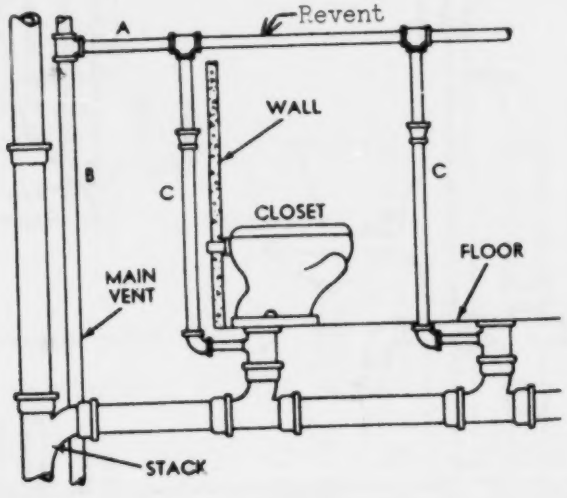
WASTE AND VENT SYSTEMS

There are five different types of vent systems and, all are acceptable in the military, however they may differ from state and local codes.

There are some disagreements as to the value of the different types of systems. All systems permit air to enter and equalize pressure, thus preventing trap seal loss by siphonage.

Because the individual vent is connected to each fixture it is considered the BEST.

1. INDIVIDUAL VENT

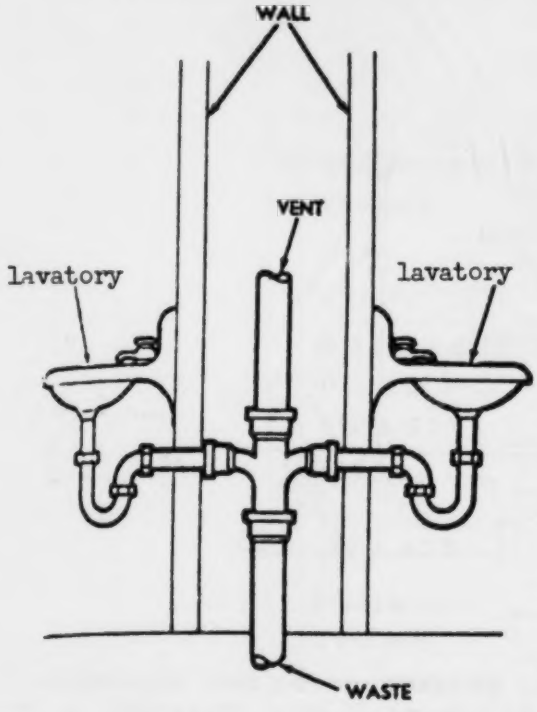


The vent from each fixture may be taken out the roof separately, however in most cases this would be a waste of pipe, therefore, it is connected to the revent (see A) which is connected to the main vent, and then taken out the roof or connected to the waste stack above the last set of fixtures, and then taken out the roof. Revents are connected 6" above the fixture overflow. If the overflow on a lavatory is 30" off the floor then the revent will be 36" off the floor. If a fixture has a low overflow, such as a water closet, it is standard practice to install the revent 36" off the floor.

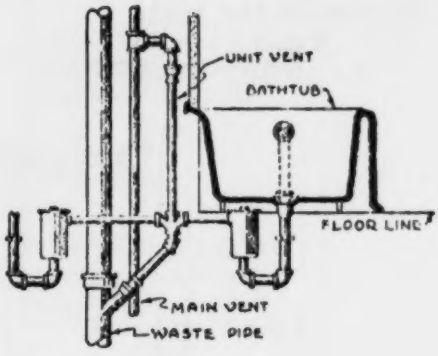
2. UNIT VENT

The unit vent or common vent is used where there are similar fixtures installed back to back, such as lavatories, or bathtubs in apartment buildings, BOQs or latrines.

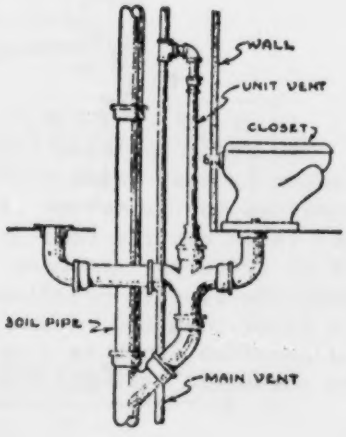
lavatories unit vented



bathtubs unit vented



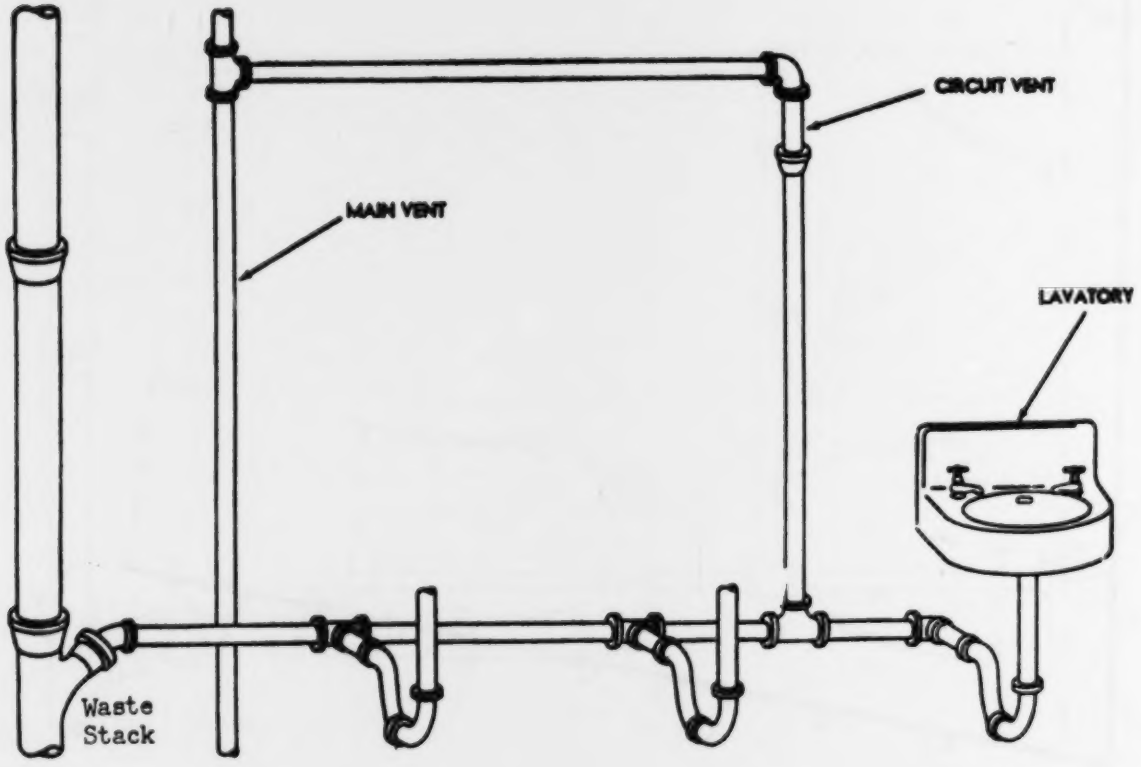
water closets unit vented



3. CIRCUIT VENT

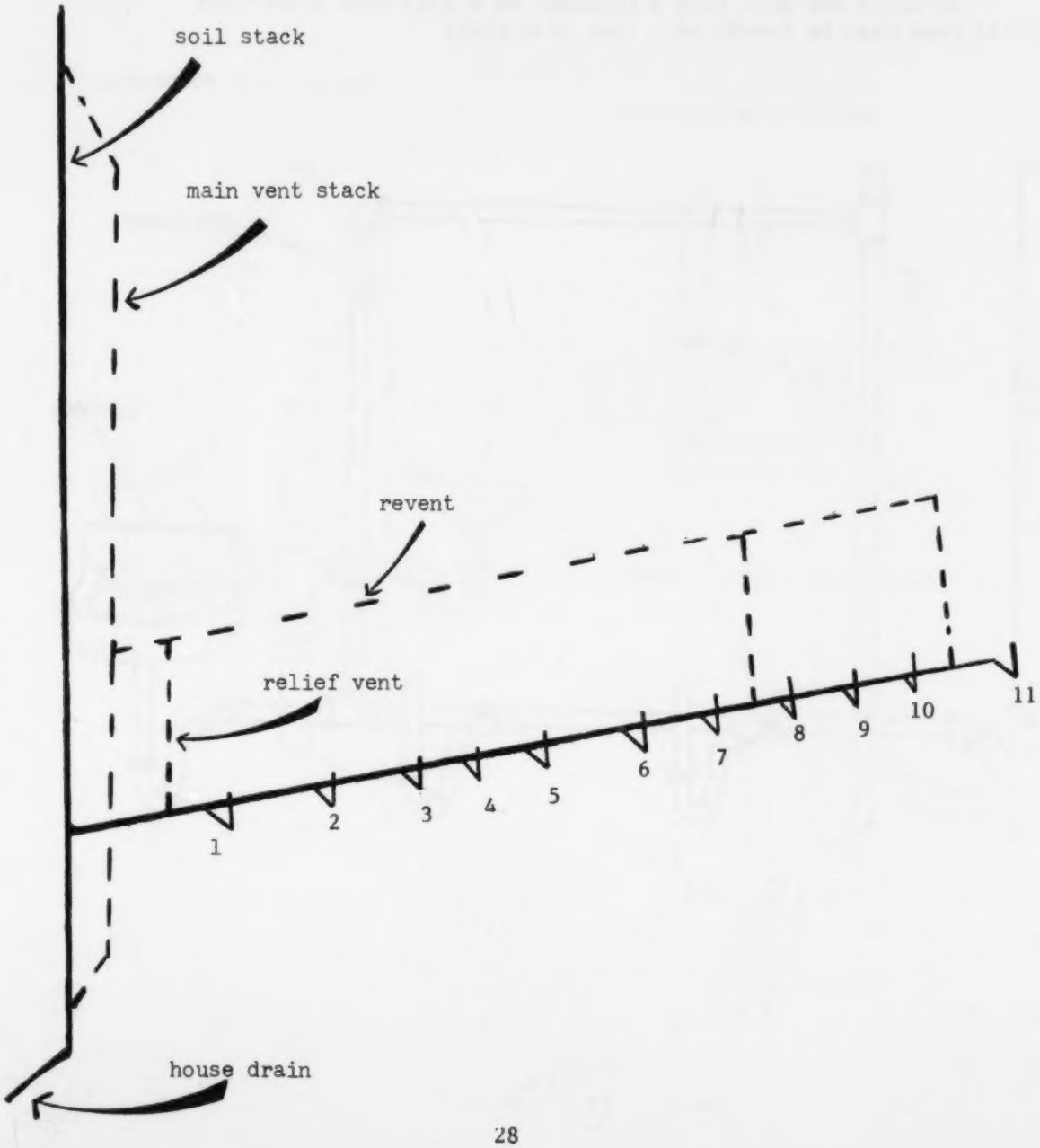
The circuit vent is used where there are more than two and less than nine fixtures installed on a branch line. The vent is installed between the last two fixtures on the line.

If there are more than 8 fixtures on a line then a modified circuit vent must be installed. (see next page)



3a. MODIFIED CIRCUIT VENT

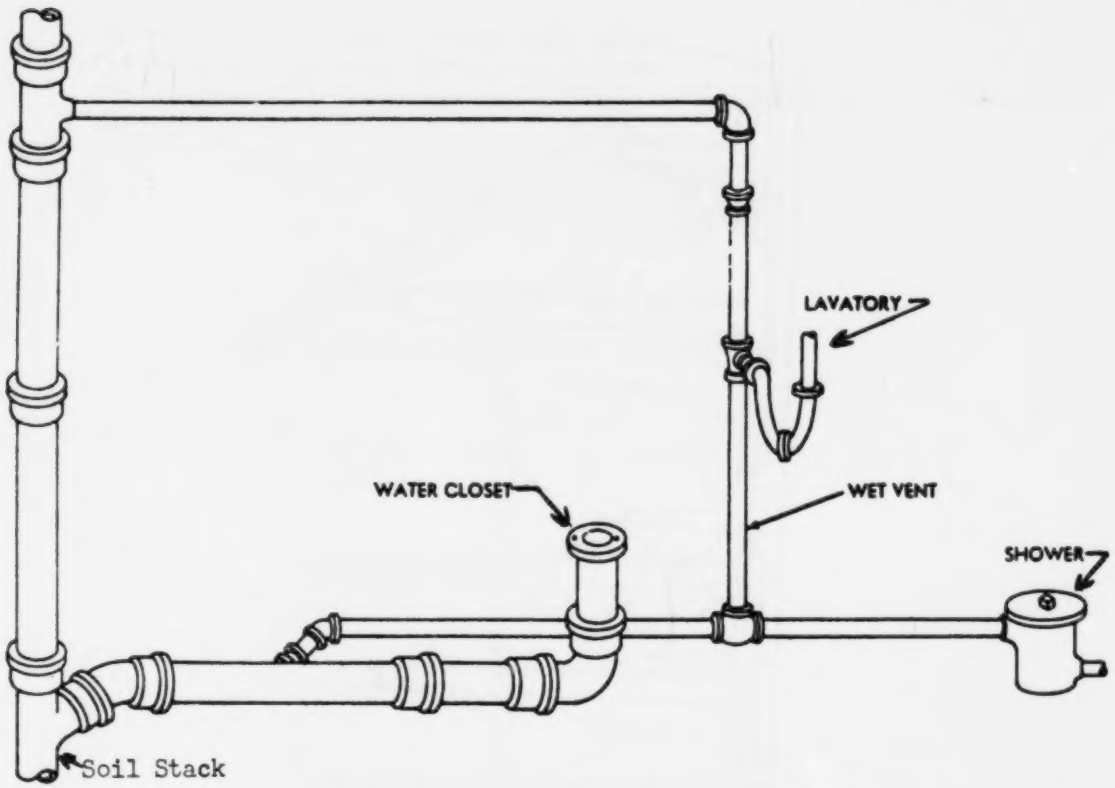
In a modified circuit vent a relief vent is required between the soil stack and the first fixture on the branch line. For each third fixture after 8, another vent must be installed from the revent to the branch line, as in the drawing below.



4. WET VENT

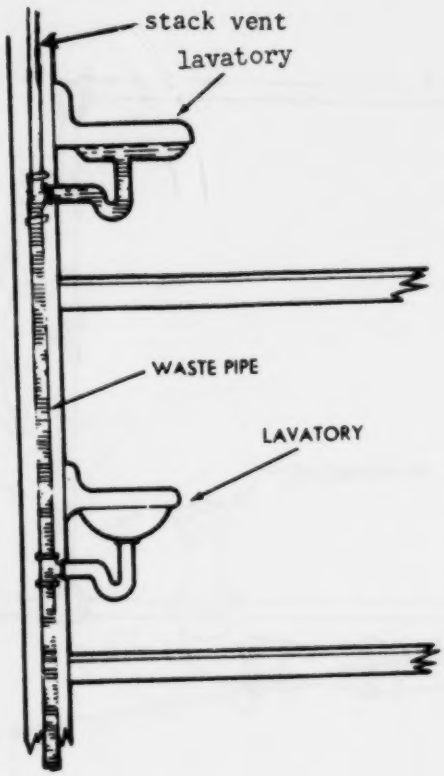
The wet vent is a part of the vent line through which liquid wastes flow from another fixture that has an individual vent. It is used most commonly on a small group of bathroom fixtures such as a lavatory, water closet, shower or bathtub.

In the drawing below the lavatory is individually vented, and the shower, and water closet are wet vented.



5. STACK VENT

The stack vent is a wet vent, in which water flows part of the time. It is used only with fixtures that have a low discharge rate, such as lavatories, and drinking fountains.



lavatories stack vented.

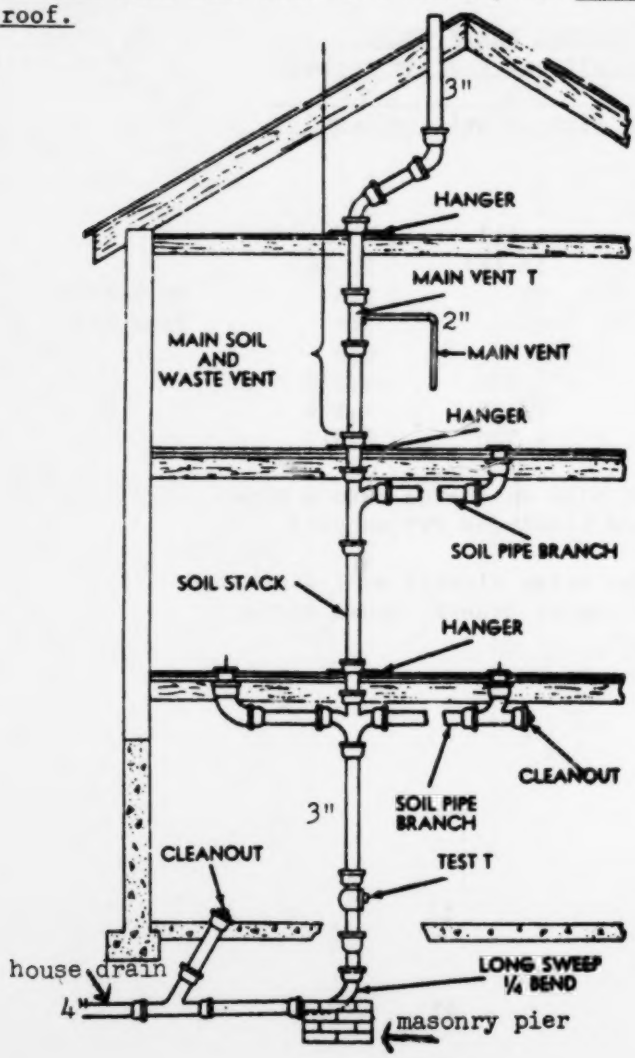
MILITARY PLUMBING SYSTEMS

SIZING THE WASTE AND VENT SYSTEM

The waste system is sized by fixture unit values. Studies conducted by the uniform plumbing code committee determined that a fixture unit value of 1 is given to a fixture having a maximum discharge rate of 7 1/2 gallons per minute. Each fixture has a fixture unit value determined by the maximum discharge rate.

The fixture unit values determine the pipe size.

The minimum size house drain is 4 inches.
The minimum size soil stack is 3 inches.
The mimimum size main vent is 2 inches, and should extend 1 foot above the roof.



The tables below are used to size the waste system:

FIXTURE UNIT TABLE

1.

FIXTURES	UNIT VALUE
Drinking Fountain	1/2
Lavatory or wash basin	1
Floor drain	1
Kitchen sink	2
Bathtub	2
Laundry tray	2
Shower	2
Slop sink	3
Urinal	5
Water closet	6

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HORIZONTAL DRAIN CHART

Size of pipe (inches)	SLOPE (fall per foot in inches) 1/8	1/4	1/2
	Maximum fixture units allowed		
1 1/4	1	1	1
1 1/2	2	2	3
2	3	6 (a)	8 (a)
3	15 (b)	18 (b)	21 (b)
4	84	96	114
5	162	216	264
6	300	450	600
8	990	1,392	2,220
10	1,800	2,520	3,900
12	3,084	4,320	6,912

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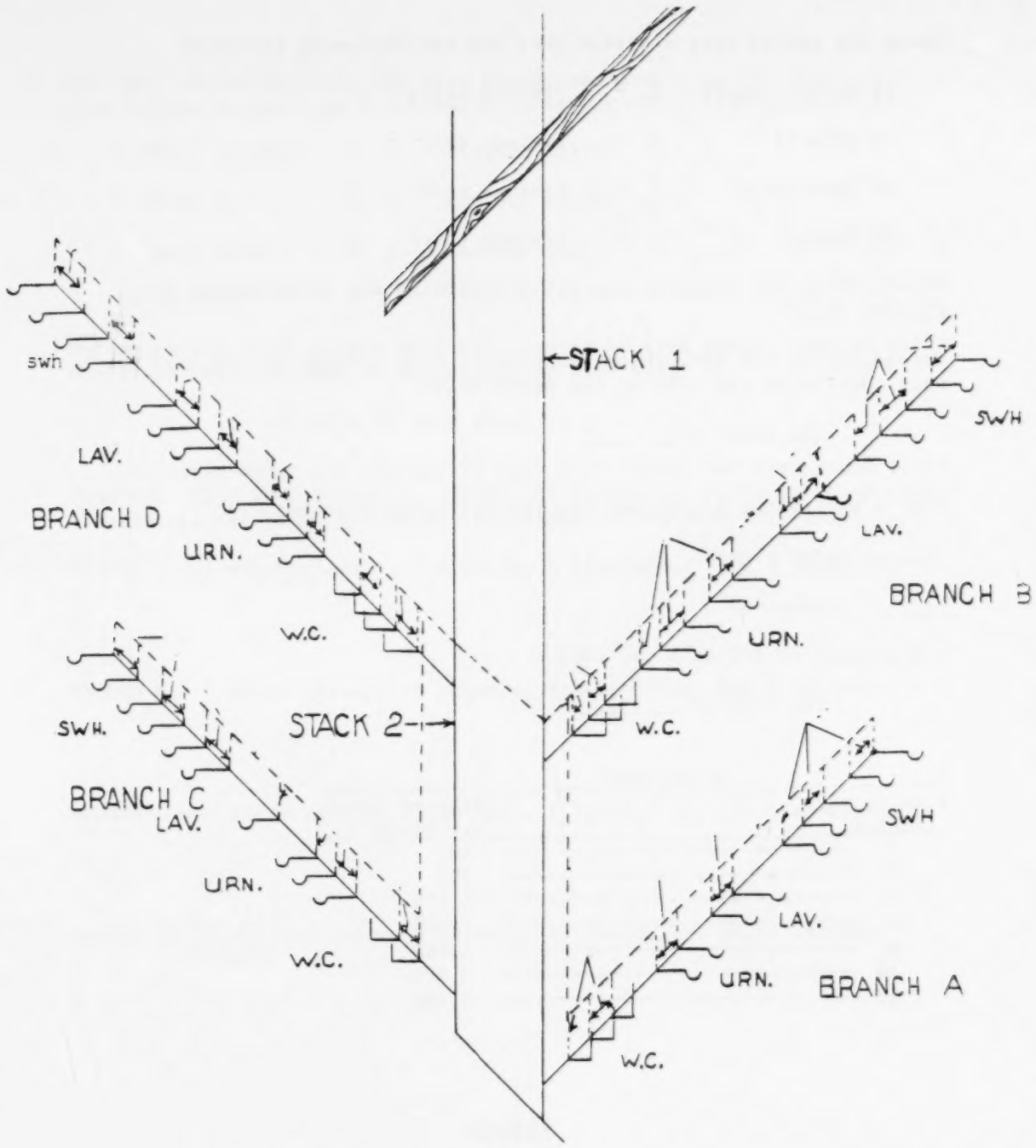
(a) No water closet will discharge into a pipe smaller than 3 inches (includes DWV copper)

(b) No more than two water closets will discharge into any 3 inch horizontal branch, house drain, or house sewer:


STACK 1
STACK 2
SWH
LAV.
BRANCH D
URN.
W.C.
SWH
LAV.
URN.
BRANCH B
W.C.
SWH.
BRANCH C
LAV.
URN.
W.C.
SWH
LAV.
URN.
BRANCH A
W.C.

Using the tables size a system that has the following fixtures:

12 water closets X = fixture units

14 urinals X = fixture units

10 lavatories X = fixture units

20 showers X = fixture units

First, using the fixture unit table determine the total number of fixture units.

Second, using the horizontal drain chart with a slope of 1/4 inch per foot, determine the size of the house drain.

the size is _____

Size a horizontal drain that has the following fixtures:

_____ water closets

_____ lavatories

and a slope of 1/2 inch per foot.

the size is _____

STACK CHART

Size of pipe (inches)	Fixture units per stack
3	60
4	500
5	1,100
6	1,900
8	3,600
10	5,600
12	8,400

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Now that the house drain has been sized, you must size the stack, for this system we will use 2 stacks, each having the following fixtures:

6 water closets	X	=	fixture units
7 urinals	X	=	fixture units
5 lavatories	X	=	fixture units
10 showers	X	=	fixture units

Determine the total number of fixture units on each stack, then go to the stack chart on page 34 and determine pipe size.

the size of each stack is _____

The house drain and the stacks have been sized, now the branch lines from the stack must be sized. Using the horizontal drain chart on page 32 size the following branches: The slope is 1/2 inch per foot.

BRANCH A - 3 water closets, 2 urinals, 2 lavatories, and 5 showers.

BRANCH B - 3 water closets, 5 urinals, 3 lavatories, and 5 showers.

BRANCH C - 2 water closets, 3 urinals, 1 lavatories, and 6 showers.

BRANCH D - 4 water closets, 4 urinals, 4 lavatories, and 4 showers.

ANSWERS

BRANCH A _____ BRANCH B _____ BRANCH C _____ BRANCH D _____

The waste system has now been sized. The remaining lines are vent lines, they are sized using the following tables: As with the waste line the stacks will be sized first as there is no vent directly on the house drain.

To determine the size of the main vent, first determine the size of the soil stack. Second, determine total number of fixture units connected to the stack. Then determine the total developed length of the vent stack. The developed length of the main vent is 83 feet, for each stack.

Branch A & B are on stack 1 and branch C & D are on stack 11

Vent Stack 1 _____
Vent Stack 11 _____

VENT CHART FOR MAIN VENTS

Diameter of soil or waste stack, in.	No. of fixture units connected	Maximum permissible developed length of vent, ft. Diameter of vent, in.							
		1 1/2	2	2 1/2	3	4	5	6	8
1 1/2	8	150							
2	12	75	310						
2	24	70	300						
2 1/2	42	35	140	450					
3	30	30	80	260	650				
3	60	18	75	240	600				
4	100		38	100	260	1,100			
4	250		22	95	240	1,000			
4	500			70	180	750			
5	550			28	70	320	1,000		
5	1,100			22	50	240	750		
6	950				20	95	240	1,000	
6	1,900				18	70	180	750	
8	1,800					30	80	350	1,100
8	3,600					25	60	250	800
10	2,800						30	80	350
10	5,500						25	60	250

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Size the revent for each branch by first determining size and slope of each branch (page 35) then developed length of each revent. Each revent is 45 feet long. Read the size of the revent in the table below.

Branch (A) Revent _____ Branch (B) Revent _____

Branch (C) Revent _____ Branch (D) Revent _____

MINIMUM DIAMETERS AND MAXIMUM LENGTHS OF CONTINUOUS, CIRCUIT, AND LOOP VENT FOR HORIZONTAL SOIL AND WASTE BRANCHES.

Diameter of horizontal branch (Inches)	Slope of horizontal branch (inches per foot)	Diameter of vent (inches) (maximum developed length of vent in feet given below)							
		1 1/4	1 1/2	2	2 1/2	3	4	5	6
1 1/4	1/8	NL[1]							
	1/4	NL							
	1/2	NL							
1 1/2	1/8	NL	NL						
	1/4	NL	NL						
	1/2	NL	NL						
2	1/8	NL	NL	NL					
	1/4	290	NL	NL					
	1/2	150	380	NL					
2 1/2	1/8	180	450	NL	NL				
	1/4	96	240	NL	NL				
	1/2	49	130	NL	NL				
3	1/8		190	NL	NL	NL			
	1/4		97	420	NL	NL			
	1/2		50	220	NL	NL			
4	1/8			190	NL	NL	NL		
	1/4			98	310	NL	NL		
	1/2			48	160	410	NL		
5	1/8				190	490	NL	NL	
	1/4				97	250	NL	NL	
	1/2				46	130	NL	NL	
6	1/8					190	NL	NL	NL
	1/4					96	440	NL	NL
	1/2					44	220	NL	NL
8	1/8						190	NL	NL
	1/4						91	310	NL
	1/2						38	150	410

[1]The abbreviation "NL" means "no limit" Actual values in excess of 500 feet:

Now that the vent system has been sized, the chart below may be used to determine the size of the vent pipe connected to each fixture where individual venting is used.

INDIVIDUAL VENTING CHART

Fixture	Minimum size of vent in inches
Lavatory	1 1/4
Drinking fountain	1 1/4
Sink	1 1/2
Shower	1 1/2
Bathtub	1 1/2
Laundry tub	1 1/2
Slop sink	1 1/2
Urinal	2
Water closet	2

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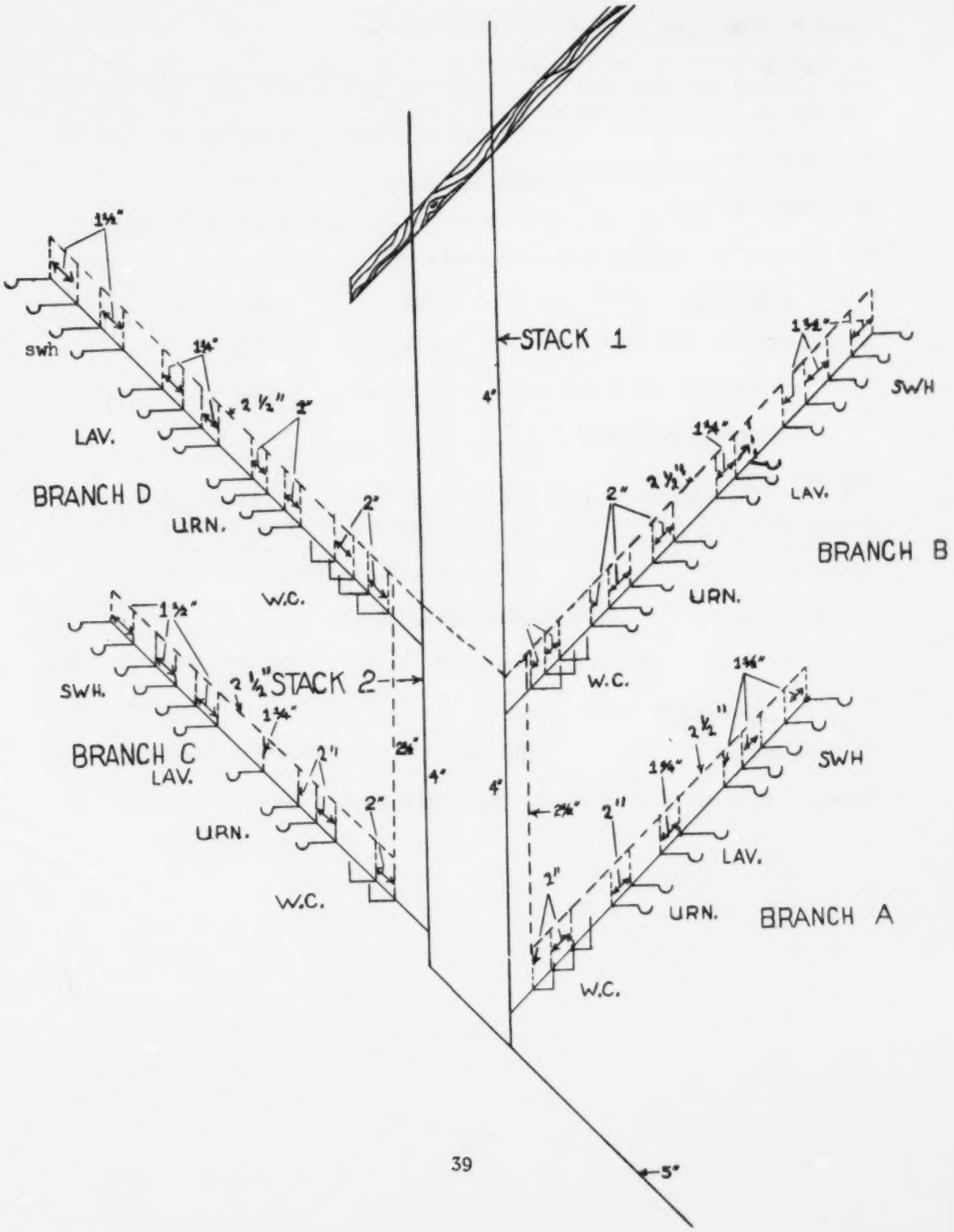
Drinking Fountain _____

Shower _____

Water closet _____

On the next page is an isometric drawing of the waste and vent system you have just sized.


STACK 1
STACK 2
BRANCH A
BRANCH B
BRANCH C
BRANCH D
SWH
LAV.
URN.
W.C.
4"
5"
2"
2½"
1¼"
1½"

TESTING PROCEDURES

1. WATER _____

2. AIR _____

3. PRESSURE _____

4. CHEMICALS _____

*T/O Structures Time/Man-hours (Schedule 40)

MATERIALS	UNITS	MH (per)
4" and smaller Cast Iron Pipe	145 joints	.85
3/4" and smaller Galvanized Pipe	185 joints	1.00
ROUGH-IN FIXTURES		
Bathtub w/ Shower	20 units	19.
Lavatory	20 units	14.
Water Closet	20 units	16.
Kitchen Sink	20 units	12.
	(Round-up to nearest ten)	TOTAL
EXCAVATION		
By Hand Method	cy	1.75

*denotes data taken from Const. Mgmt TM 5-333

T/O SEWERAGE SYSTEMS

The general purpose of the rest of the portions in this workbook is to introduce you to T/O Sewerage Systems and the code that governs the system. This system may or may not be considered expedient, depending on the type of materials that are used.

COLLECTION SYSTEM

1. Sewer Pipe and Connections

   a.

   b.

   c.

   d.

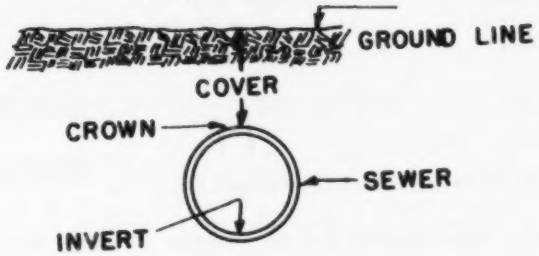
   e. No connections with the waterlines

   f. The sewer line shall be no closer than 5′ horizontally, and 2′ vertically below a waterline. All sewer lines that are relatively close to these dimensions will be made with cast iron soil pipe, lead and oakum joints.

OTHER DETERMINING FACTORS

1. Velocity between 2′ and 10′ FPS
2. 1% Slope
3. Elimination of Bends greater than 45°
4. Frost line in particular areas

2. Sewer lines required a minimum of 2′ of cover, provided the line is not subject to heavy loads. If the line is run under a road or is subject to heavy loads, it requires 4′ of cover.

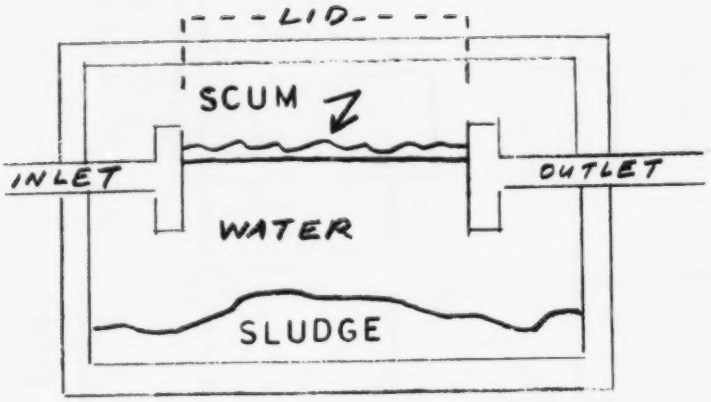


MINIMUM COVER

USE OF MANHOLES

A. Change of Direction
B. Change of Slope
C. Change of Pipe Size
D. Every 600′ if Pipe is Larger Than 18"
E. Every 400′ if Pipe is Smaller Than 18"
F. At the End of ALL Laterals

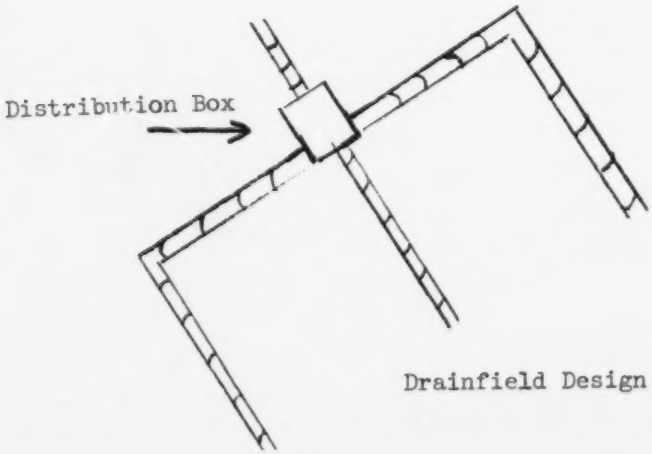
Septic Tank Design



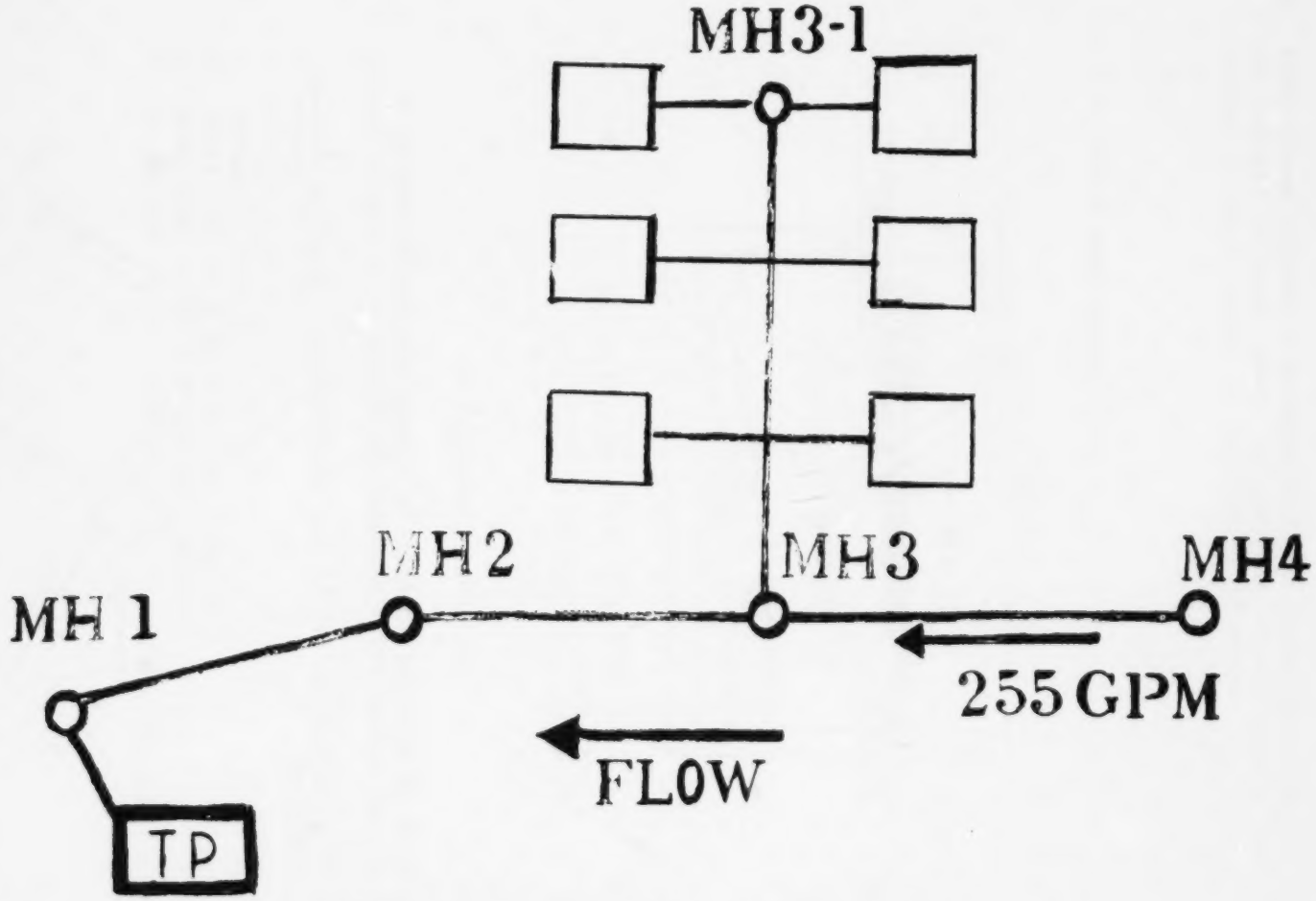
** FACTS TO REMEMBER **

SLUDGE - is 2% of your entire total of sewage and decays through a process called PURIFICATION. 50% to 80% of it can be burned.

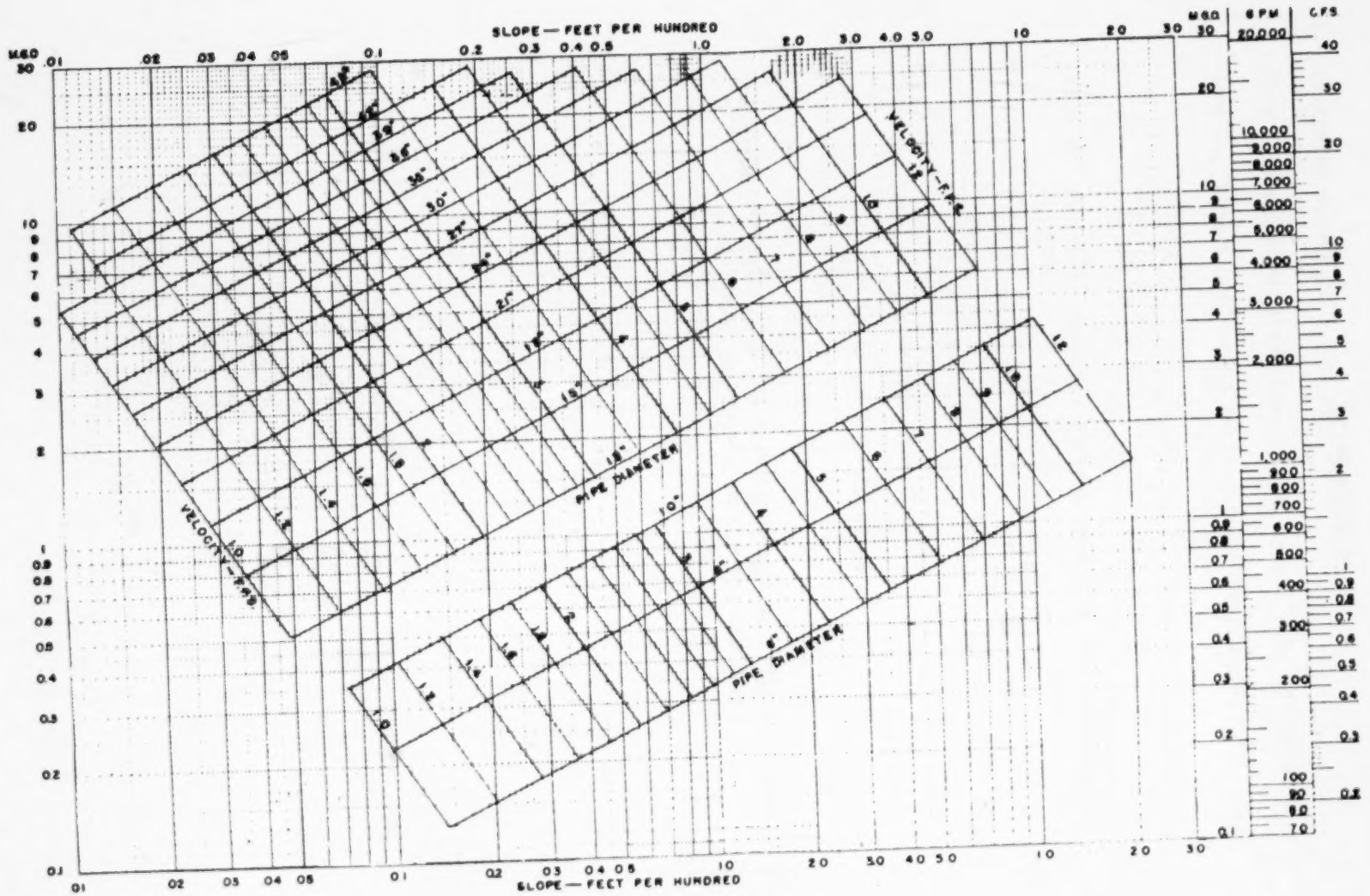
LIQUIDS - Comprises about 98% of the total sewage. Disolves through AERATION.



Drainfield Design



COLLECTION SYSTEM



PIPE FLOW CHART

MANNING'S FORMULA (N = .013 FOR 12" PIPE AND LARGER) (N = .014 FOR 10" PIPE AND SMALLER)

Pipe flow chart—Manning's formula

STUDENTS NOTES

8. DETERMING SLOPES

Step 1. Determine Elevations (MH #1 193.20′)(MH #2 192.05′)

Step 2. Obtain Difference in Elevations (VD/Vertical Distance)

$$\begin{array}{r} 193.20' \\ -\ 192.05' \\ \hline 1.15' \text{ VD} \end{array}$$

Step 3. Determine Distance Between Manholes (HD/Horizontal Distance)

$$\begin{array}{r} 1+14.6 \\ -\ 0+00.0 \\ \hline 1+14.6 \end{array} = 114.6' \text{ (HD)}$$

Step 4. Divide Step 3 into Step 2

$$\begin{array}{ll} \text{(VD)} & \frac{1.15'}{114.6'} = .01 \times 100 = 1\% \text{ Slope} \\ \text{(HD)} & \end{array}$$

PROBLEM: Referring to the drawing on the next page, determine the slope from manhole #2 to the septic tank.

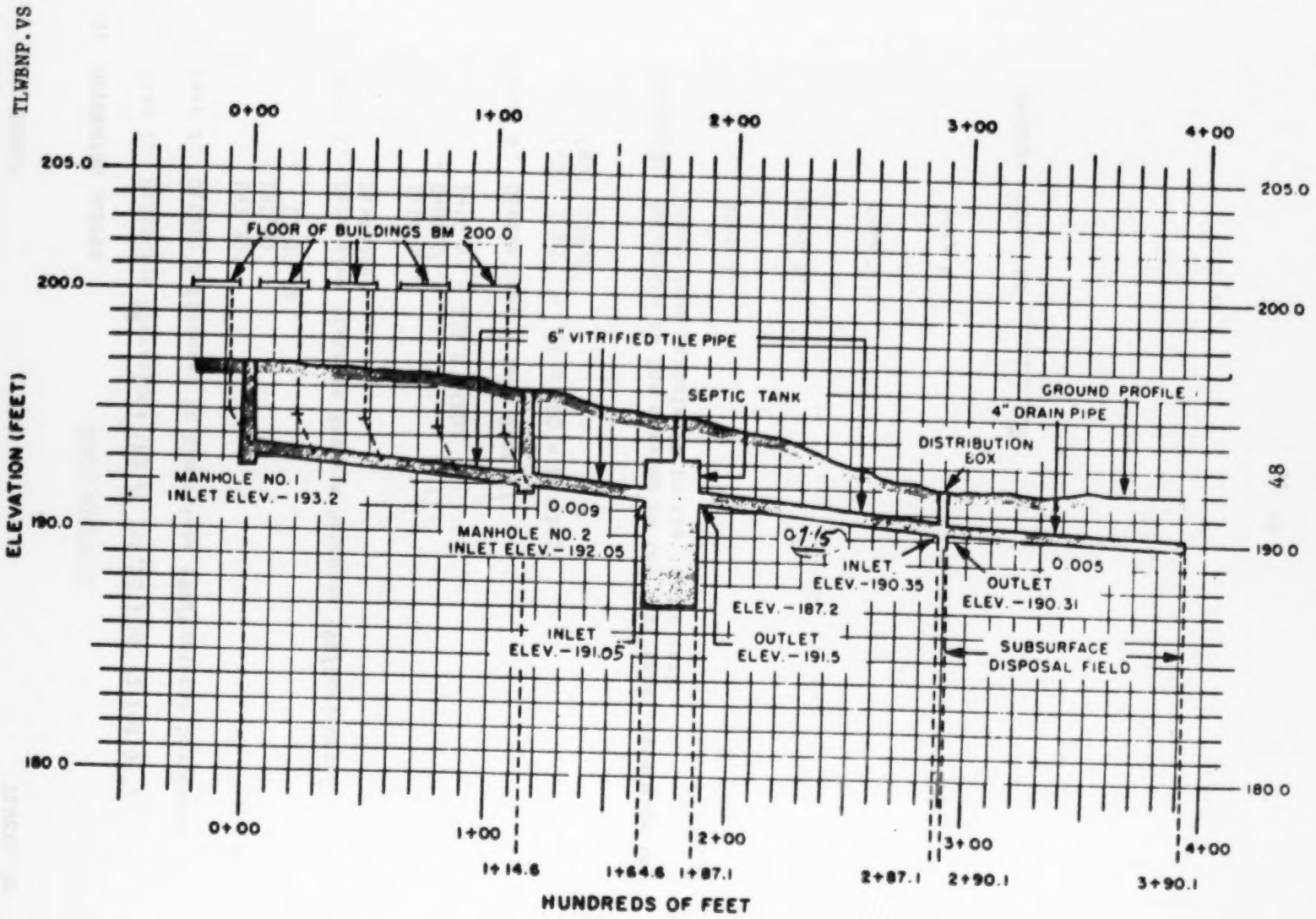
Step 1.

Step 2.

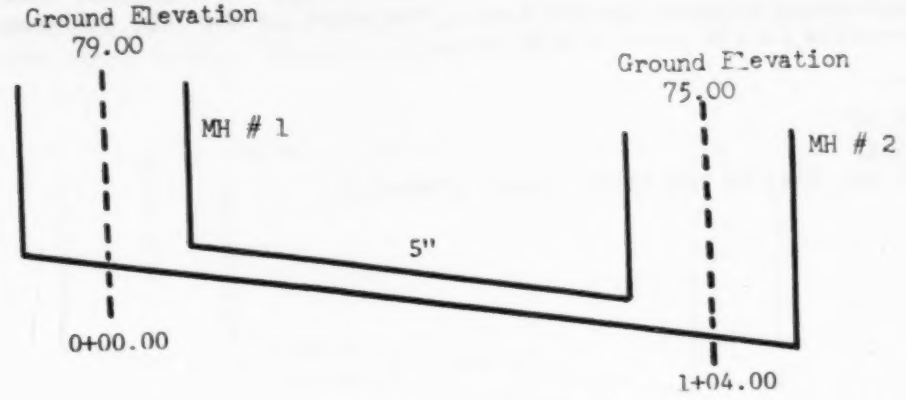
Step 3.

Step 4.

ANSWER: Slope is _____%.


TLWBNP.VS
0+00
1+00
2+00
3+00
4+00
205.0
200.0
190.0
180.0
FLOOR OF BUILDINGS BM 200.0
6" VITRIFIED TILE PIPE
SEPTIC TANK
GROUND PROFILE
4" DRAIN PIPE
DISTRIBUTION BOX
MANHOLE NO. 1
INLET ELEV. - 193.2
0.009
MANHOLE NO. 2
INLET ELEV. - 192.05
0.015
INLET
ELEV. - 190.35
0.005
OUTLET
ELEV. - 190.31
ELEV. - 187.2
INLET
ELEV. - 191.05
OUTLET
ELEV. - 191.5
SUBSURFACE
DISPOSAL FIELD
48
ELEVATION (FEET)
1+14.6
1+64.6
1+87.1
2+87.1
2+90.1
3+90.1
HUNDREDS OF FEET

9. **Determing Invert Elevations**



1. Determine Slope: $\begin{array}{r} 79.00' \\ -\ 75.00' \\ \hline 4.00' \text{ VD} \end{array}$ $\begin{array}{r} 1+04.00' \\ -0+00.00' \\ \hline 1+04.00' \text{ HD} \end{array}$ $\frac{4.00 \text{ VD}}{104 \text{ HD}} = .04 \times 100$ 4% Slope

2. Determine Cover: Light Load/2 Feet

3. Determine Pipe Size: (Number of Inches in one ft) $\frac{5 \text{ Inches}}{12 \text{ Inches}} = .416'$ or $.42'$

4. Subtract Cover and Pipe Size from Ground Elevation

$$\begin{array}{r} 79.00' \\ 2.42' \\ \hline 76.58' \end{array}$$ Initial Invert Elevation (This is at the center of the higher manhole).

5. Determine Upper Invert Elevation at the Outside of the Higher Manhole:

   Multiply the distance from the center of the manhole to the outside of the manhole (2') by the slope. In this problem 4% is changed to a decimal form: 2 x .04 = .08 FT. Therefore, .08 Ft is the difference in elevation, so the Upper Invert Elevation is 76.58 - .08 = 76.5.

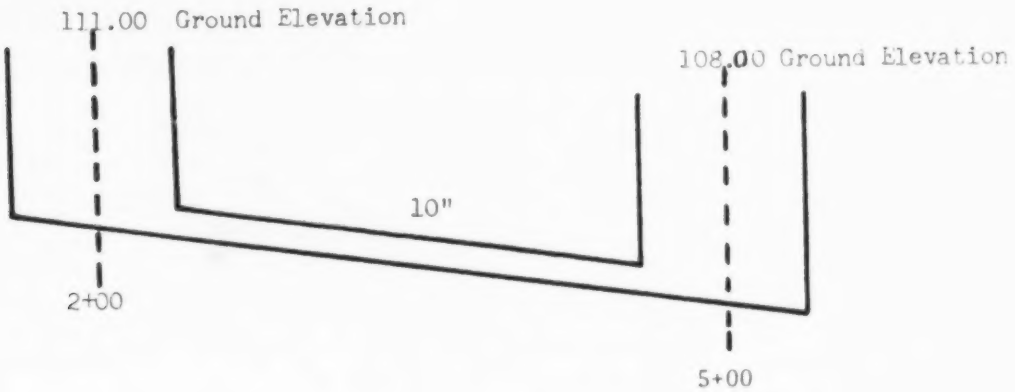
6. Determine Lower Invert Elevation (where the pipe goes into the lower manhole).

Multiply the distance from the outside of the upper manhole to the outside of the lower manhole by the slope, changed to a decimal form. The horizontal distance is 100 feet. The slope is 4%. The difference in elevation is 100 x .04 = 4.00 feet.

76.50'
- 4.00
72.50 This is the Lower Invert Elevation

PRACTICAL EXERCISE

Determine the INITIAL, UPPER, and LOWER INVERT ELEVATIONS of the sewer line shown below. Assume a heavy load.



a. **INITIAL INVERT ELEVATION** _____

b. **UPPER INVERT ELEVATION** _____

c. **LOWER INVERT ELEVATION** _____

STUDENT NOTES

TREATMENT FACILITIES

1. GENERAL PURPOSE PERCOLATION TEST

   a. Procedure

      (1)

      (2)

      (3)

      (4)

      (5)

   b. Application Rate (See Annex C, Page 54)

   c. Test Hole Conditions

      (1) Cesspool

      (2) Tile drainfield

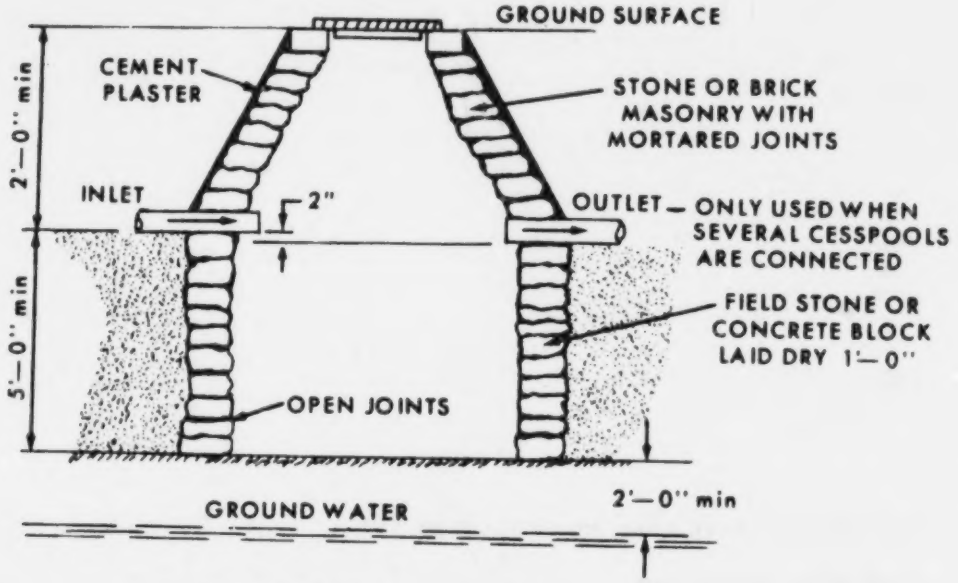
      (3) Lagoon

10. CESSPOOL DESIGN

A cesspool is an open jointed receptacle usually constructed of dry laid brick or field stone. The water seeps through the sides and the solids remain in the bottom. It is constructed for no more than 50 men. The diameter is between 5′ and 12′, and the depth should be no deeper than 2′ above the groundwater table. Active leaching cesspools will be constructed a minimum of 20′ apart.

* IMPORTANT

PERK HOLES WILL ALWAYS BE DUG AT 1/2 PROPOSED DEPTH



CESSPOOL — DETAIL

APPLICATION RATES OF SEWAGE FOR CESSPOOLS

TIME IN MINUTES REQUIRED FOR WATER TO FALL ONE INCH IN TEST HOLE	ABSORPTION IN GALLONS PER SQUARE FOOT OF PERCOLATING AREA PER DAY
1	5.3
2	4.3
5	3.2
10	2.3
30	1.1

TOTAL ABSORPTIVE AREA = AREA OF WALLS (BELOW THE INLET) + AREA OF THE BOTTOM

TOTAL ABSORPTIVE AREA = $(2\pi R)$ (HEIGHT) + πR^2

DIAMETER	DEPTH Below Inlet	AREA IN SQUARE FEET
5′	5′	99
6′	6′	142
7′	6′	170
8′	6′	201
8′	7′	216
9′	7′	262
9′	8′	293
10′	8′	330
12′	10′	489

Cesspool Design

Determine:

a. Flow Rate of sewage in G.P.D.

b. Absorption Rate in Gallons per FT^2 per day.

c. Water Table

d. Assume a diameter and radius

e. Area Required

f. Area of Bottom

g. Area of Sides

h. Depth

Example: Assume a flow rate of 1,000 G.P.D., an absorption rate of 5.3 G.P.D. per FT^2, and a water table of 12′. The diameter is 8′ and the radius of 4′.

Area Required: $\frac{1,000}{5.3} = 189\ FT^2$

Area of Bottom: $\pi \times R^2$ $\pi = 3.14$

$R = 4'$ $R^2 = 4 \times 4 = 16'$ $16 \times 3.14 = 50.24\ FT^2$

Total Area = $189.00\ FT^2$

$- 50.24$

$138.76\ ft^2$

Area of Side = D x π x DEPTH

$8' \times 3.14 = 25.12$

Depth = $\frac{138.76}{25.12} = 5.52'$ or 5′ 6"

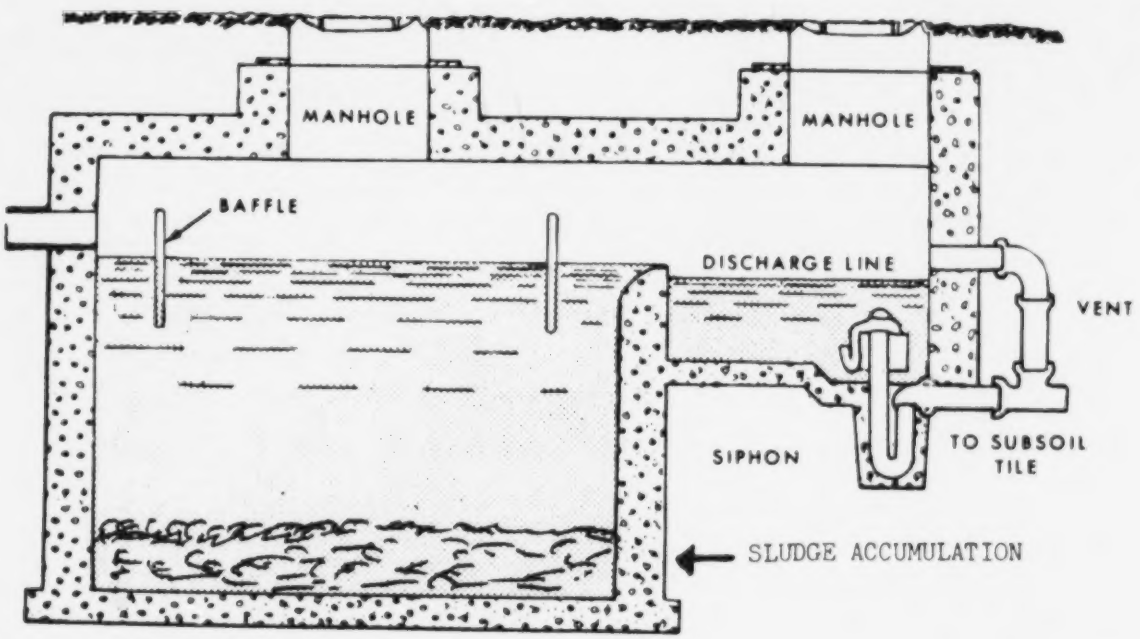
PRACTICAL EXERCISE

What is the required depth for a leaching cesspool to support a facili having a sewage flow rate of 1,000 gallons per day (G.P.D.)? The cesspool will be located in an area having an absorption rate of 4.3 $GAL/FT^2/DAY$. The cesspool diameter is 8 feet and the radius is 4 feet.

STUDENT NOTES

11. Septic Tank Design

The minimum size septic tank is 500 gallons. The septic tank operates on the principle of anaerobic bacteria decomposition, the volume of sewage in gallons per day, which is 70% of the water demand. NOTE: THE DRAINFIELD IS ALWAYS A PERMANENT PART OF A SEPTIC TANK SYSTEM.



Septic tank with dosing siphon.

PRACTICAL EXERCISE

Assume 2,000 G.P.D. + 25% for Sludge Accumulation.

2,000 x 1.25 = _____ Total Gallons Per Day (G.P.D.) for design

Change gallons to cubic feet by dividing by 7.5.

$$V \frac{\text{Total G.P.D.}}{7.5 \text{ gal/FT}^3} = \_\_\_\_\_ \text{ Cubic Feet}$$

Depth: $\frac{\text{Cubic Feet}}{\text{\# from 4 - 12}}$ = _____ Sq. Ft.

Width: $\frac{\text{Square Feet}}{\text{\# from 4 - 12}}$ = _____ Length

Allowing one foot freeboard for the depth, the final dimensions will be:

_____ DEPTH _____ _____ _____ WIDTH _____ LENGTH

PRACTICAL EXERCISE

Assume 3,300 G.P.D. + 25% for Sludge Accumulation

3,300 x 1.25 = _____ _____ Total G.P.D. for Design

Change gallons to cubic feet.

$$\frac{\text{Total G.P.D.}}{7.5 \text{ gal/FT}^3} = \frac{\text{_____}}{7.5} \text{ Cubic Feet}$$

$$\frac{\text{Cubic Feet}}{\#4 - 12 \text{ (Depth)}} = \text{_____ Square Feet}$$

$$\frac{\text{SQ FT}}{\#\text{ from } 4 - 12 \text{ (Width)}} = \text{_____ Length}$$

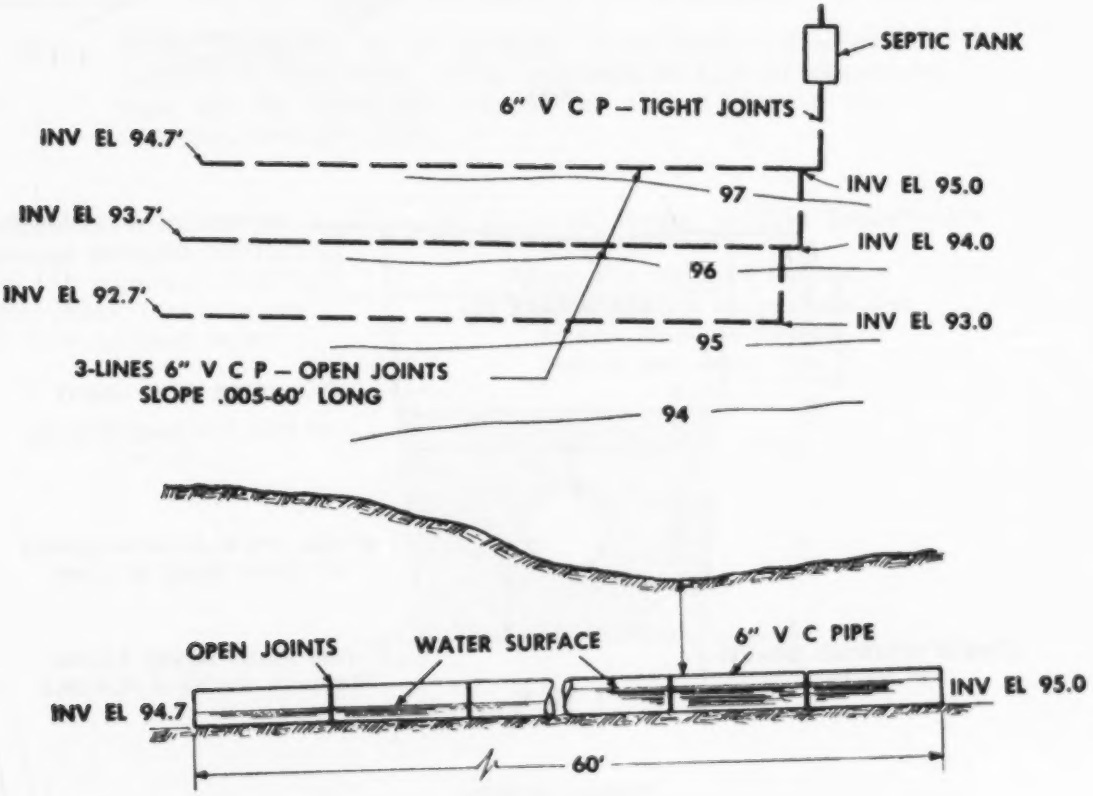
Check Length: At least 2 but not more than three times the width

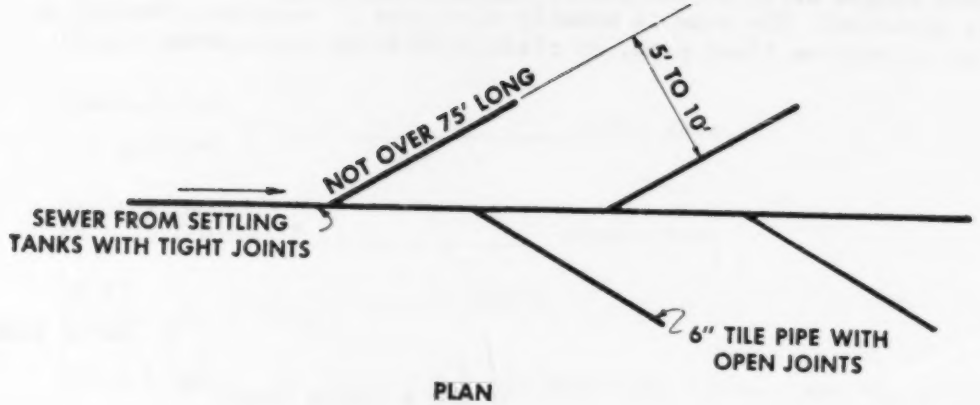
Allowing 1 foot freeboard for depth, the final dimensions will be:

_____ DEPTH _____ WIDTH _____ LENGTH

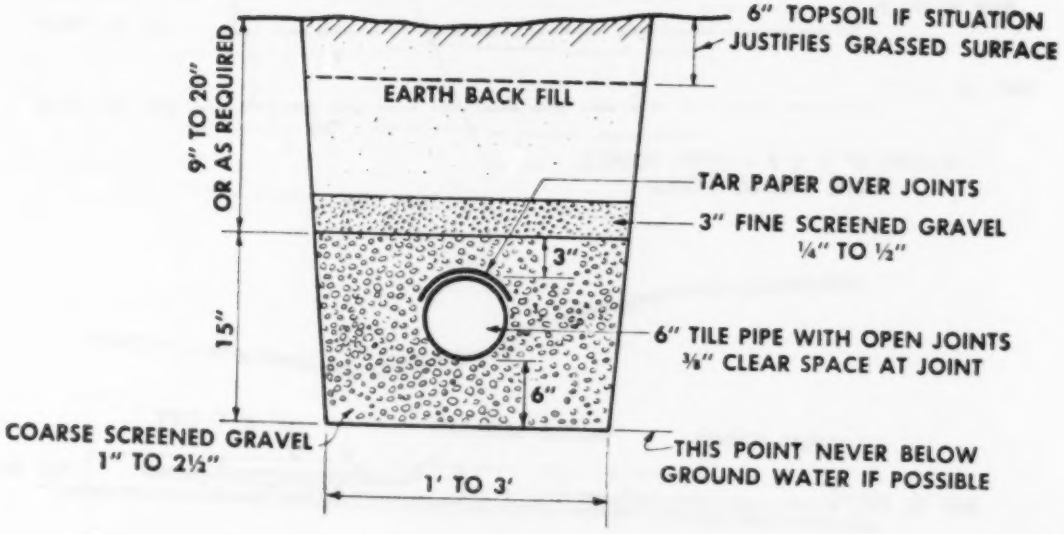
12. TILE FIELD DESIGN

Drain of Tile fields are always a permanent part of the septic tank system. The lines extend from the effluent side of the tank to a maximum length of 75′. The pipe is opened jointed 3/8", between 3 and 6" in diameter. The pipe is usually clay pipe 1′ section. However it can be bituminous fiber pipe, or plastic if it is perforated.





PLAN


6" TOPSOIL IF SITUATION JUSTIFIES GRASSED SURFACE
EARTH BACK FILL
9" TO 20" OR AS REQUIRED
TAR PAPER OVER JOINTS
3" FINE SCREENED GRAVEL ¼" TO ½"
3"
15"
6" TILE PIPE WITH OPEN JOINTS ⅜" CLEAR SPACE AT JOINT
6"
COARSE SCREENED GRAVEL 1" TO 2½"
THIS POINT NEVER BELOW GROUND WATER IF POSSIBLE
1' TO 3'

TYPICAL SECTION

MINIMUM CAPACITIES FOR SEPTIC TANKS SERVING ONE BLDG

Number of Rooms	Person	Liquid Cap. of Tank (gal)	Recommended inside dimensions: Length		Width		Liquid depth		Total depth	
			Ft	In	Ft	In	Ft	In	Ft	In
2 or less	4	500	6	0	3	0	4	0	5	0
3	6	600	7	0	3	0	4	0	5	0
4	8	750	7	6	3	6	4	0	5	0
5	10	900	8	6	3	6	4	6	5	6
6	12	1100	8	6	4	0	4	6	5	6
7	14	1300	10	0	4	0	4	6	5	6
8	16	1500	10	0	4	6	4	6	5	6

NOTE: IF IN THE FUTURE IT IS EXPECTED TO INCREASE THE NUMBER OF ROOMS IN A STRUCTURE, IT IS RECOMMENDED THAT ALLOWANCE BE MADE FOR THE INCREASED SIZE OF THE SEPTIC TANK IN THE ORIGINAL CONSTRUCTION.

Table 3-3. Subsurface Application Rates of Sewage in Tile Drainfields

Time (in minutes) required for water level to drop 1 inch in test hole.	Allowable rate of sewage application in gallons per square foot of trench bottom per day.
1	4.0
2	3.2
5	2.4
10	1.7
30	0.8
60	0.6

DRAIN FIELD DESIGN

ABSORPTION RATE: 4 G.P.D. FT^2 OF TRENCH, 1250 G.P.D.

$$\text{AREA REQUIRED} = \frac{\text{G.P.D}}{\text{ABSORPTION RATE}}$$

$$\text{AREA REQUIRED} = \frac{1250}{4} = 312\ FT^2$$

$$\text{LENGTH OF TRENCH} = \frac{\text{AREA}}{\text{WIDTH}} \qquad 18" = 1.5'$$

$$\text{LENGTH OF TRENCH} = \frac{312\ FT^2}{1.5'} = 208'$$

LATERALS NOT GREATER THAN 75'

$\frac{208}{75} = 2.77$ 3 Trenches

$\frac{208}{3} = 69.33$ 70' Long

PRACTICAL EXERCISE

What length trench and number of laterals are required for a drainfield to support a facility having a discharge of 4,875 gallons per day? A percolation test resulted in a one inch drop in five minutes. The width of the trench is 36 inches. Assume all laterals are no longer than 75 feet in length.

PRACTICAL EXERCISE

What length trench and number of laterals are required for a drainfield to support a facility having a discharge of 2,000 gallons per day? A percolation test resulted in a one inch drop in ten minutes. The width of the trench is 24 inches. Assume all laterals are no longer than 75 feet in length.

TILE DRAINFIELD DESIGN

Besides the fact that there are different absorption rate charts for surface irrigation, tile drainfields, sewage lagoons and cesspools, the following test hole conditions should be met:

(1) For tile drainfields, the bottom of the 1-foot square test hole should roughly conincide with the proposed depth of tile.

(2) Table to indicate approximate absorption rates for tile drainfields is listed in table 3-3.

OTHER TYPES OF COLLECTIONS

1. FRENCH DRAINS - _____
_____

2. TIE-IN WITH LOCAL AND EXISTING SEWER - _____
_____

SEWAGE LAGOON

A sewage lagoon is a shallow "dish" which collects influent from a facility or installation. The lagoon is between 2 and 5′ in depth. The process of decomposition is through aerobic bacteria. The desired retention time is between 60 to 90 days. The flow line of the lagoon is in the opposite direction of the prevailing winds, and a minimum of 300′ must be cleared before constructing a lagoon.

** Rule Of Thumb - 100 men per acre

Formula - $\frac{\text{(Population) (B.O.D. Load/Person/Day/Pounds)}}{\text{20 - B.O.D. Load \# Acres/Day}}$

Assume B.O.D. = .2 #/Per/Day

1000 Man-Troop Camp

$\frac{(1000)\ (.2)}{20} = \frac{(100)\ (.2)}{2} = 10$ Acres

1 Acre = 43,560 $FT.^2$ $10 \times 43{,}560 = 435{,}600$

$435{,}600 = 660\ FT^2$

II.

CONSTRUCTION DRAWING AND PRINT READING AND PREPARING A PLUMBING BILL OF MATERIALS (130M)

A. Introduction

B. Types of Drawings

1. Plan view - Is a cutaway overhead view showing centerline of pipe and horizontal runs of drains, waste and vents - also electrical lines.

2. Isometric - The plumber uses isometric pipe diagrams to help visualize what is required to install the piping. It gives him a 3 dimensional view of his portion of the job.

C. Interpretation of symbols and reading drawings.

1. Standard symbols - are found in TM 5-302 drawing number 0101. Plumbing plans have four types of symbols:

a. Line symbols for piping.

b. Pipefitting symbols for pipe unions, couplings, and connections.

c. Valve symbols to show control points in the system.

d. Symbols showing the various plumbing fixtures required by the plan.

2. Drawing numbers

Identified in the schedule of drawings affixed to the title block. Located in lower right hand corner. The first four digits of a facility indicate the construction drawing number in Chapter 7, TM 5-302 Extract

3. General Notes

a. Contains all updated information pertaining to the drawing.

b. These notes have precedence over other drawings.

4. Schedule of drawings.

A list of drawings concerned with the project (standard and special detail).

5. Standard Details

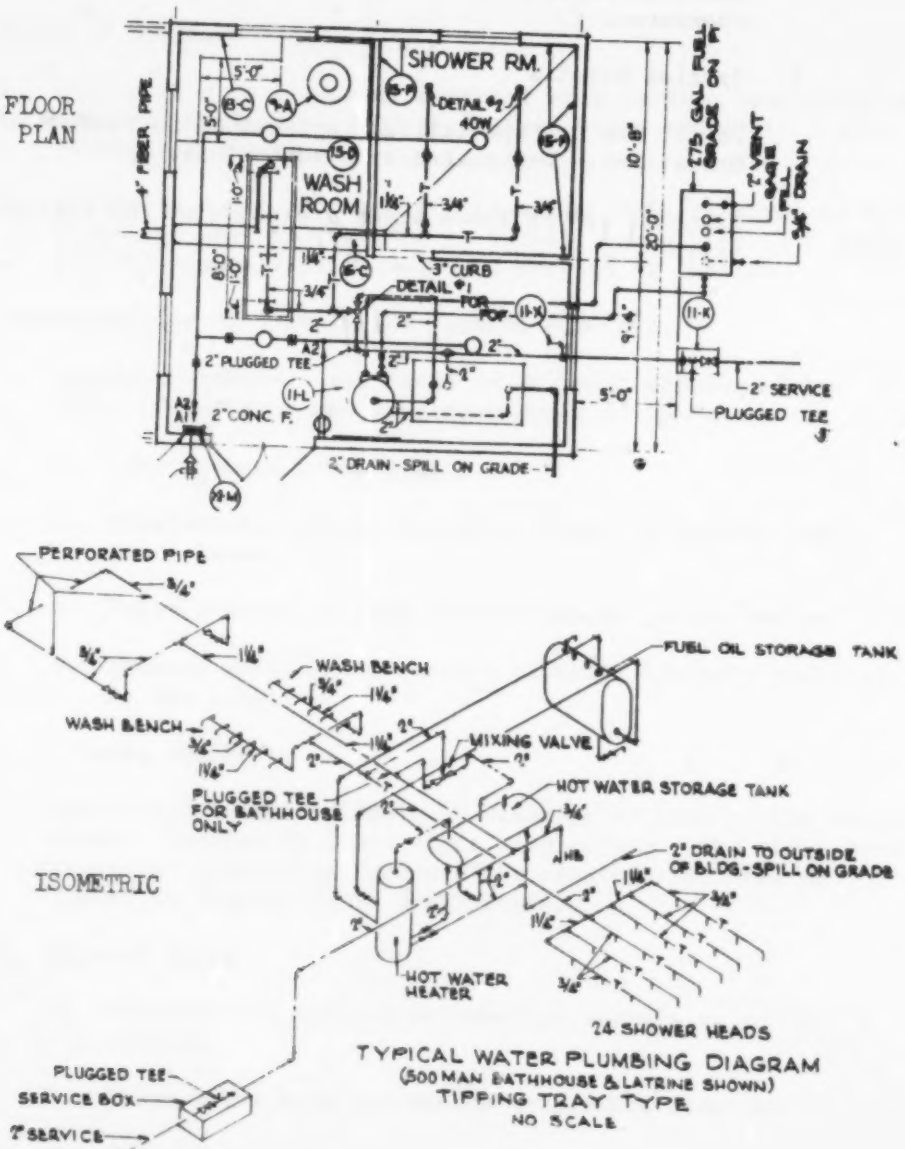
Construction details that are common to two or more facilities are shown on drawing 99-98. These construction details are identified by a circle symbol consisting of a numerial digit followed by a single or double alpha-character.

6. Special Details

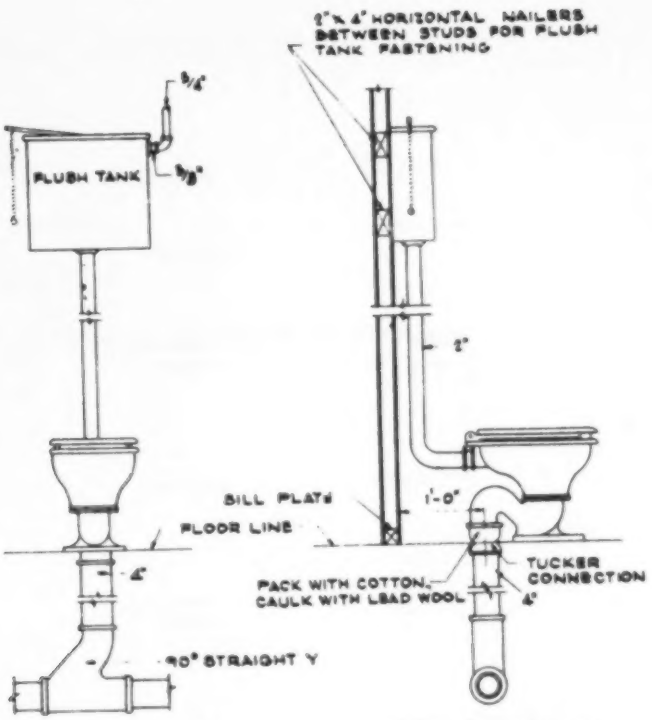
Detail for one specialized application in Theater of Operations. Designated by a number only.

Examples of the above items are shown on the following pages.

There are two types of drawings used by the plumber, the floor plan and the isometric. The floor plan gives a top view, and the isometric gives a three dimensional view. Both are necessary to install a plumbing system.



STANDARD DETAILS



WATER CLOSET PLUMBING
NO SCALE

11-G

EXAMPLE SPECIFICATIONS

Water heater shall be model number B97, as manufactured by A.O. Smith Corporation, or an approved equal. Heater shall be gas fired as approved by the American Gas Association for use on high temperature service. Heater shall bear N.S.F. seal of approval. Heaters shall have an input rating 97,000 B.T.U. capable of suppling 81.5 G.P.H. at 100°F.

VALVES	Meaning	Illustration
	Gate Valve	
	Gate Valve Angled	
	Globe Valve	
	Globe Valve Angled	

SYMBOLS/ABBREVIATIONS	MEANING	ILLUSTRATION
Faucets		
PB	Plain Bibb	
HB	Hose Bibb	
	Concentric Reducing Coupling	
	Eccentric Reducing Coupling	

D. Bill of Materials (DA FORM 2702)

1. Take offs

a. Isolate

b. Starting Point

c. Check and List

2. Estimate of materials not found on drawings

a.

b.

c.

d.

e.

f.

g.

h.

i.

3. Allowances for waste and loss

a. Fittings

b. Pipe

c. Fixtures

4. Additions

a. Couplings

b. Unions

E. Example Number One

1. Problem:

Using drawing number 72-32, Facility number 732202 160 man or 80 Officer bathouse and latrine, page 52, of TM 5-302 extract do the following:

a. List the non-adjusted bill of materials for the tempered waterline starting with the 2 1/2" x 2" bushing at the mixing valve

b. List each type and size of pipe used in the waste system.

c. List the total number and size of vents (VTR) in the Plumbing system

F. Problem #2

1. Requirements

Using the drawings for the 500-man bathhouse and latrine Drawing number 73-32, page 52 of TM 5-302 extract list the following:

a. Non-adjusted bill of materials for the shower room starting with the first tee.

b. The total number and size of vents (VTR) used in the plumbing system.

c. Type and size of all pipes used in the drainage system.

d. What size water supply line connects directly to the water closet flush tank.

e. The spacing between the pipe straps on the flush pipe for the urinal.

2. Solution;

a.

Fittings	Size	Quantity
Tee		
Elbow		
Bushing		
Nipple		
Other		

b. Vents: How many _____ What size _____

c. Drainage pipes Type _____ _____ Size _____ ___

d. Water line size _____

e. Pipe straps spacing _____

III. Utilities Job Site Inspection.

TASK

You are to inspect a construction job site to insure that the plumbing system is being installed according to plans and specifications.

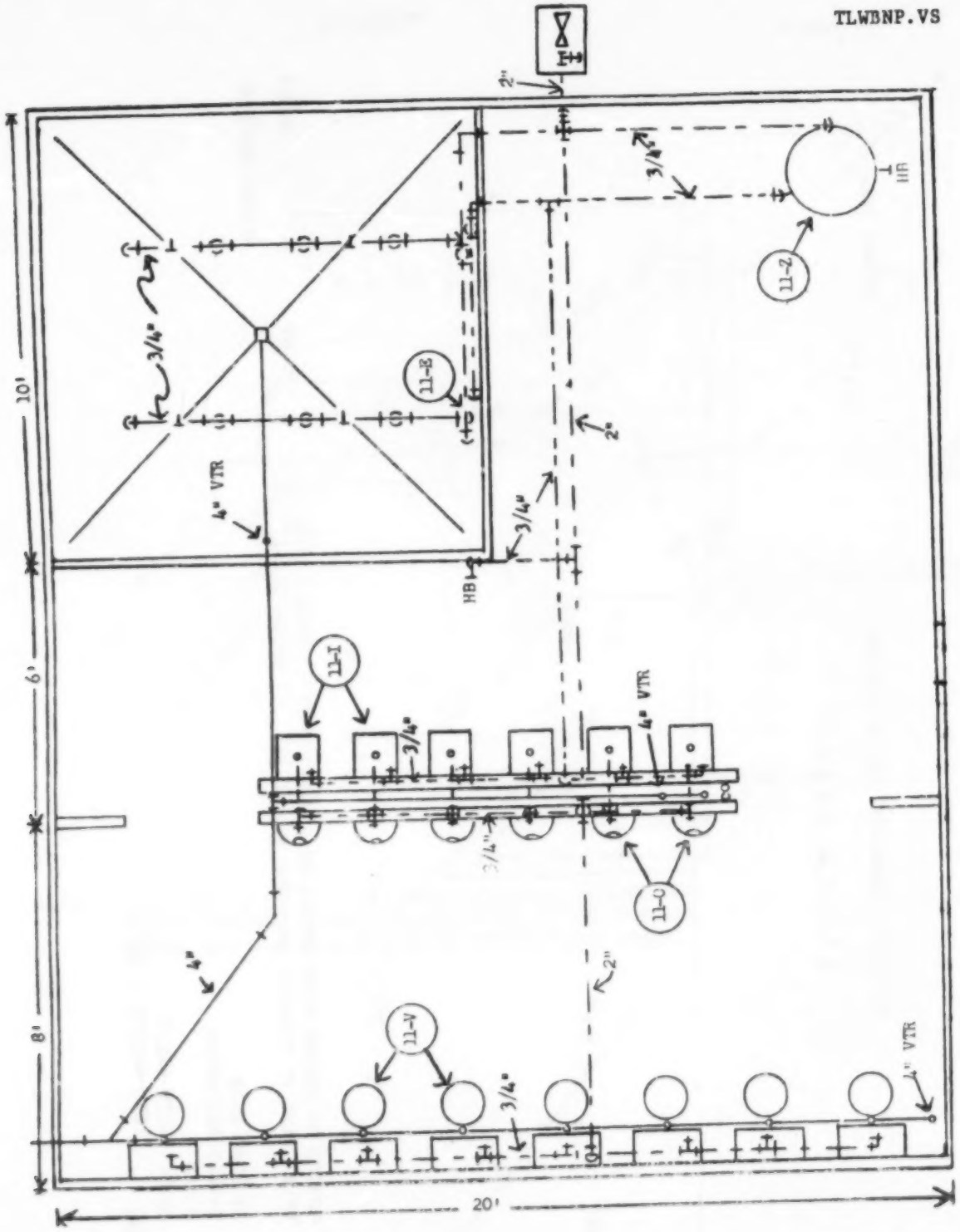
During your inspection you will find many discrepancies which you will record on the Inspection sheet provided. Some of the discrepancies are more obvious than others, when in doubt, write it down. The system is not complete; water closet not connected, or lavatory not connected is not what you are looking for.

SPECIFICATIONS

Water System — The water sytem will be installed using galvanized pipe and fittings exclusively:

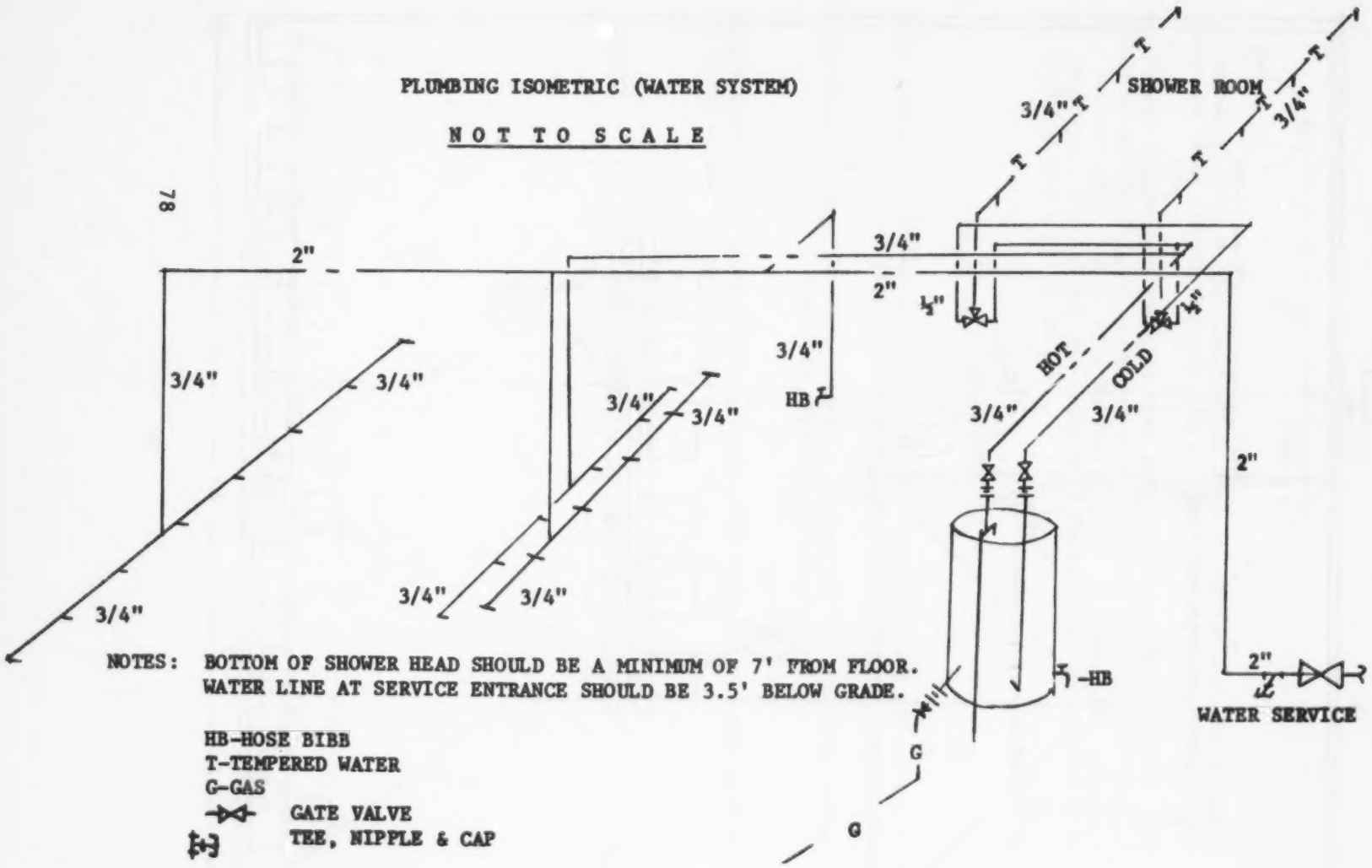
Waste/Vent System — The waste and vent system will be installed using ABS plastic pipe and fittings.

BEFORE STARTING TO INSPECT THE FACILITY, LOOK CAREFULLY AT THE DRAWINGS AND PLANS ON THE FOLLOWING PAGES:


2"
3/4"
11-Z
11-E
4" VTR
HB
11-I
11-O
11-V
10'
6'
8'
20'

PLUMBING ISOMETRIC (WATER SYSTEM)

NOT TO SCALE

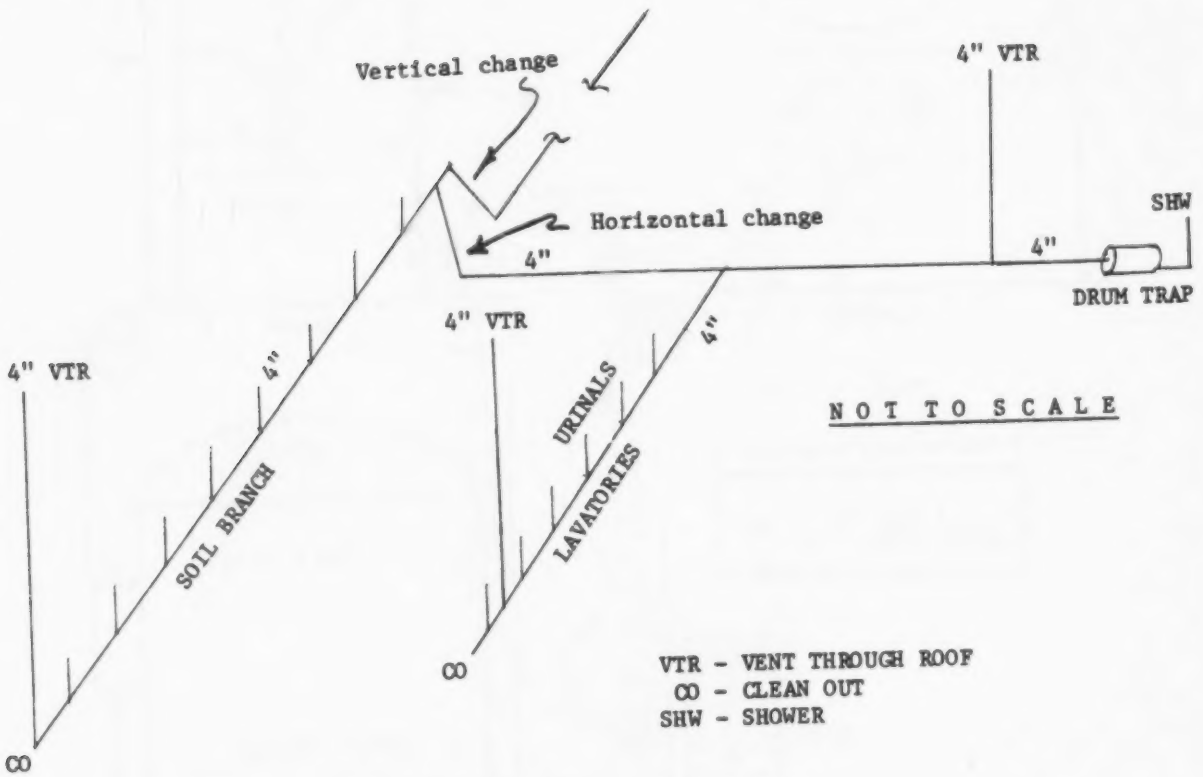


NOTES: BOTTOM OF SHOWER HEAD SHOULD BE A MINIMUM OF 7' FROM FLOOR.
WATER LINE AT SERVICE ENTRANCE SHOULD BE 3.5' BELOW GRADE.

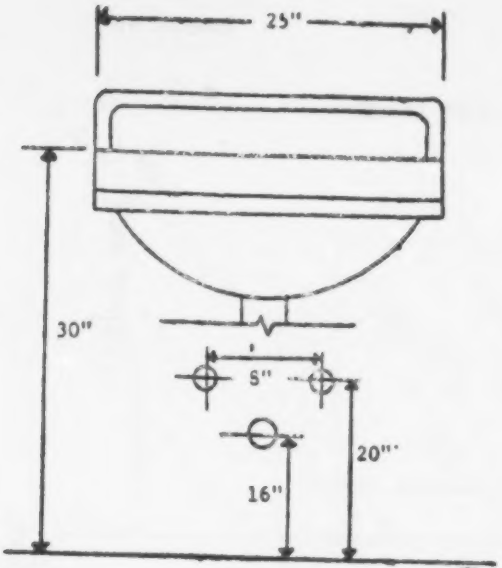
HB-HOSE BIBB
T-TEMPERED WATER
G-GAS
GATE VALVE
TEE, NIPPLE & CAP

TLWBNP.VS

PLUMBING ISOMETRIC (WASTE & VENT SYSTEM)



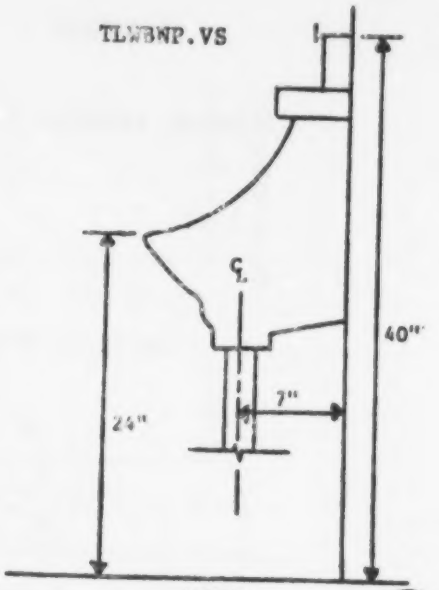
NOTE: THERE SHOULD BE 1/4" PER FOOT SLOPE TOWARD EFFLUENT.
DRAINS OUTSIDE OF BUILDING SHOULD BE 3' BELOW GRADE.
SHOWER ROOM FLOOR SHOULD TAPER TOWARD FLOOR DRAIN.



LAVATORY

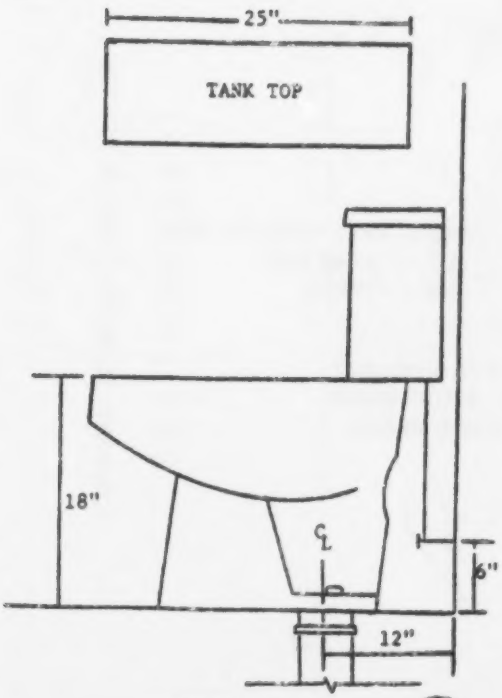
11-I

TLWBWP.VS



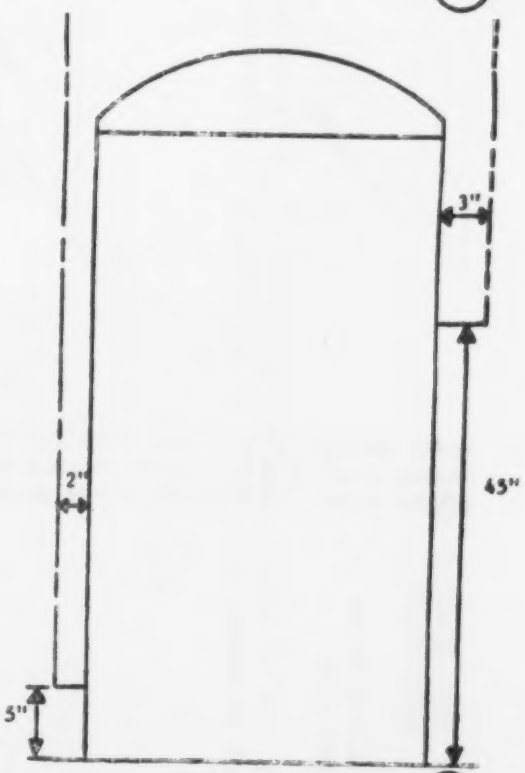
URINAL

11-O



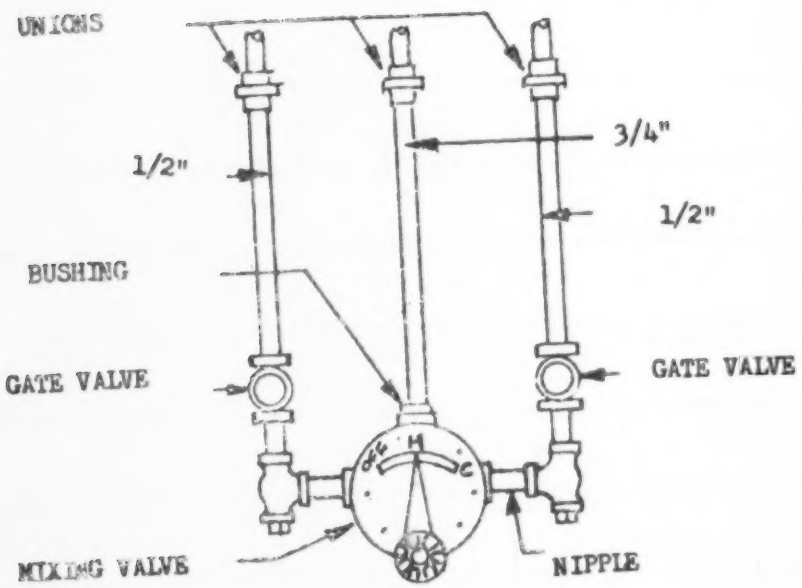
WATER CLOSET

11-V



WATER HEATER

11-Z


UNIONS
1/2"
3/4"
1/2"
BUSHING
GATE VALVE
GATE VALVE
MIXING VALVE
NIPPLE
H
C

11-E

TLWBNP.VS

NAME _____ CLASS _____

DISCREPANCIES

NUMBER	FAULT

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